Concrete

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Learning What Good Concrete Is

PRELIMINARY announcement of the 19th Annual Convention of the American Concrete Institute, to be held at Cincinnati, O., January 22-25, indicates not only a wide range of subject matter bearing on fundamental interests in making better concrete but a detailed consideration of the problems of good concrete which no other organization is giving. Although the material concrete is accumulating its own history very rapidly it is still a new material, sufficiently new to require specialized study.

In fact in the last few years we have learned things so rapidly, upset so many theories, changed so many methods of application, that it is a matter of wonder that structures erected a few years ago, when we may be said to have been grossly ignorant, are good sound structures in spite of that ignorance.

* * *

Whatever may be said of concrete's lack of elasticity, it is proven very clearly that it is elastic in its response to a wide range of treatment. Even the ignorant builder often builds better than he knows.

We have learned for instance, that for all mixtures of concrete except those used in such work as tamped block, where forms are to be removed immediately, the least amount of water which will produce a workable mix will give the best results. Yet we find concrete stone of the very finest quality being made from a mixture so wet that it pours like thick soup. It is through such experience that we find putting excess water into concrete is not necessarily harmful, providing there is no segregation of materials in placing, it is in permitting the excess water to remain there which is harmful. Thus in the high quality concrete stone referred to, the casts are made in sand molds which filter out the excess moisture. Further, the centrifugal process of pipe manufacturing requires a mixture with a great deal of excess water, yet the centrifugal action removes the excess and makes concrete of the densest kind.

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Another idea which the Institute will probably upset shortly is that there should be one standard of quality for concrete block. The concrete block business is growing. The uses of block are increasing. We learn that for face products we want one thing, for back-up another, for bearing walls one quality, for partitions another. We learn that an exceedingly porous block (and we have all the time been condemning all porous block) which will crush under a pressure of 700 pounds to the square inch, may make a better insulated wall, if covered with waterproof stucco outside, than a very dense block. We have learned that stucco sticks better to a porous block than a dense one and that stucco itself is better the leaner it is, particularly in its finishing coats. But all these statements are scarcely of general application. Whether concrete is good or not depends upon the use for which it is intended. There are exceptions to the special provisos. There are very few generalizations about making concrete which can't be picked all to pieces in special cases. That is why the material concrete is the subject of special study, which only a special organization and special agencies can give it.

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Concrete Sanitary Ware—Fatty Acids

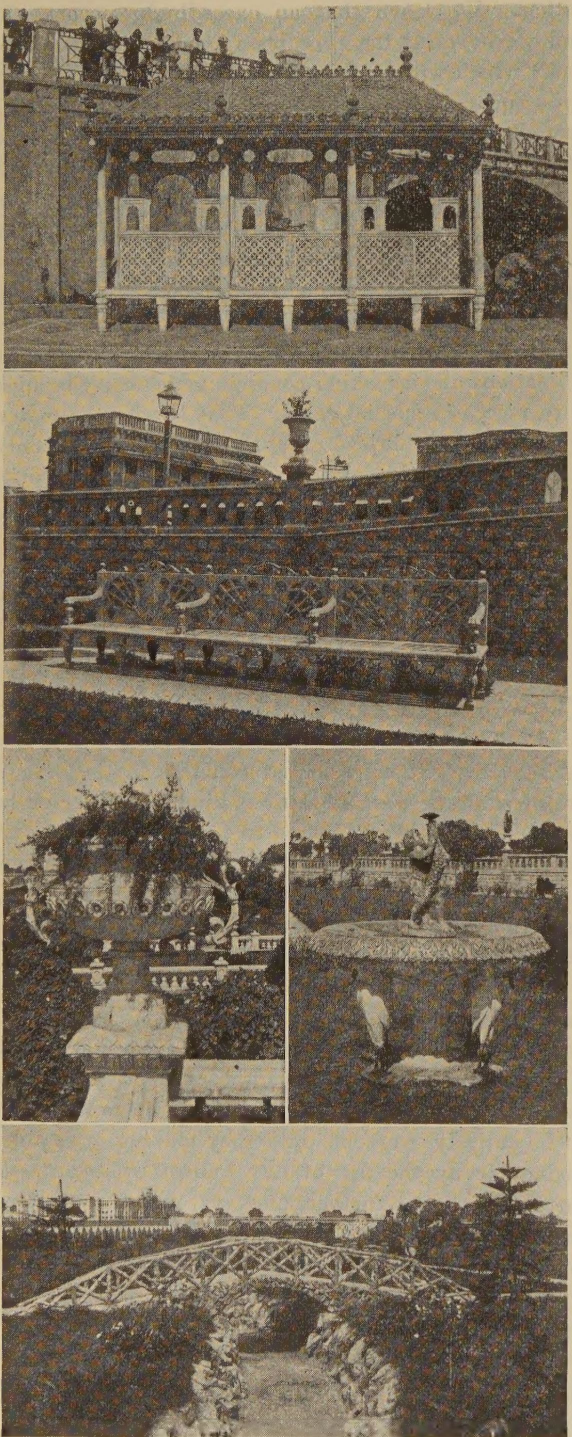
THERE is a persistent interest in the possibilities of making more extensive use of concrete in the manufacture of sanitary ware of various kinds. Sooner or later ways will probably be found to finish and surface treat concrete to make it entirely suitable for these purposes.

A recent inquiry came from a correspondent in Australia indicating his desire to extend his line of various concrete receptacles to include kitchen sinks. He feared to do so on account of the possible destruction of the concrete by fatty acids. This question was put up to the Bureau of Standards, which points out that the chief objection to sanitary ware is the absorptiveness of the concrete, which even though very slight probably cannot be entirely overcome, either by making a very dense product or by the use of any known treatment. The Bureau points out further, however, that there probably would be little to fear from the effects of vegetable fat upon the concrete in making sinks, because the contact of such fats with the concrete would generally be of short duration; in fact, such contact might be beneficial in the same way that ordinary soap is recognized as a good treatment for concrete floors. While continuous exposure of concrete to fatty acids would undoubtedly result in deterioration, the surface application of a limited quantity would not necessarily be harmful.

Ornamental Concrete in India

By C. C. Dangoria
Ames, Iowa

The accompanying illustrations from photographs indicate that while portland cement concrete has been adopted only within comparatively recent times in India it is neverthless being developed very rapidly to serve artistic purposes in ways, which, due to high labor costs, are impossible in many other parts of the world.



Figs. 1-5—(Top to Bottom) Ornamental Concrete in India

The work shown is at Hyderabad, India. It was done under the instructions of Mr. Bhaunani, the superintending engineer of the City Improvement Office. Hyderabad is the largest native state in India. It has a population of 13 million. The capital of this state with a population of 500,000 has the same name. After this city was almost entirely destroyed by heavy floods in 1908 and in the rebuilding a new department of City Improvement was established to replan the city and rebuild it along more beautiful lines. Old slums on the banks of the river are entirely cleared away, the banks raised and a beauiful park laid out parallel to the river. to the river.

Figs. 1 and 2 show seats in that park made by masons who have worked in all of the intricate designs with tiny trowels, in whose use the workmen are particularly adept. Their wages are 30 cents a day. These seats are built in place. They have rough reinforcement of wire mesh and iron rods to counteract temperature stresses and to make the work sound in spite of its very light section. Finish is of fine texture and white and looks much like marble.

Fig. 3 shows one of a number of flower vases done in a similar way. Fig. 4 is a bridge of 15 ft. span over an artificial channel connecting two fountain basins. It is made to look like bamboo and not even the closest inspection reveals to the uninitiated that it is not bamboo although the entire work is of reinforced concrete. Fig. 5 shows one of the 50 fountains in the garden, each of them of different plan and design, each with very rich detail.

Research

American industry is spending about $70,000,000 annually on scientific research, according to the Fabricated Production Department of the Chamber of Commerce of the United States.

About one-half of this sum is spent by American manufacturers in the conduct of laboratory research, while the remainder is expended in experimental and development work in plants, the department points out in a bulletin on research.

As a result of scientific research work, it is explained by the department, approximately one-half billion dollars is being saved annually by industry in this country.

"The value of scientific research, both from an economic and industrial standpoint," the department says, "has never been so fully appreciated as at the present time. The problems of the recent war forced science and its research activities to the front in all civilized countries. It is now realized by leading manufacturers that scientific investigation is a necessary adjunct to efficient cooperation. A utilization of the scientific knowledge now avaiable, and a sympathetic cooperation in the free interchange of such information will lead to the adoption of improved manufacturing processes and do much to obviate the danger of ignorant, destructive competition. The realization of this fact is shown by the 500 or more firms now maintaining laboratories for industrial research."

The percentage of voids in broken stone and gravel generally runs from 41% to 50%. Ordinary sand, as used in concreting, ranges from 31% to 38% voids.

What Quality of Concrete Block Should Become Standard?

An Open Letter by J. C. Pearson, Chief Cement Section, United States Bureau of Standards, to A. J. R. Curtis, Secretary Committee P-1, American Concrete Institute.

J. C. PEARSON'S letter is a very important contribution in the consideration of standards which shall govern the manufacture and use of concrete building units.

Last year the American Concrete Institute's Committee P-1 was almost hopelessly at loggerheads within itself.

A newly organized committee is making good progress but still finds one or two remaining difficulties in formulating a report which it can offer confidently to the Institute convention for adoption as a standard.

A new Institute standard is urgently needed. At a time when concrete building units manufacturers are getting into production on a scale as never before it is of the utmost importance that as Mr. Pearson says, the industry "find itself" and agree upon standards which may be a safe basis for municipal building regulations.

Every concrete building unit manufacturer should make it a point to be in thorough touch with the work of the American Concrete Institute along this line. The report of Committee P-1 is a vital matter—it touches that tenderest spot, the pocketbook. The Institute will hold its convention and its members act to influence the future of concrete block and structural tile at Cincinnati, January 22-25. Realizing the importance of this matter to the industry as a whole Mr. Pearson put his suggestions to Committee P-1 in an open letter, sending a copy of it to CONCRETE for publication.—*Editor.*

October 17, 1922

Mr. A. J. R. Curtis,
Secretary, Committee P-1
American Concrete Institute.

My dear Mr. Curtis:

In the lack of definite knowledge of what action the American Concrete Institute's Committee P-1, on Standard Building Units has taken since the disagreement between the majority and minority at the Annual Convention in Cleveland last February, I have been following some of the published discussion on the subject of strength requirements for concrete building units, and note a tendency to favor the adoption of a lower minimum strength requirement than that recommended in the majority report.

My personal interest in this matter has grown considerably during the past six months, because, in the unprecedented building boom which this city is now experiencing, we have been called upon to test a considerable number and variety of building units. Our experience with these has naturally involved more or less frequent reference to the old American Concrete Institute Standard "No. 10" and to the recommendations of the two factions of Committee P-1, and it has also fostered some thought on the discussions which have appeared and in the related paragraphs of a number of building codes, some proposed and some adopted.

Believing that certain test data and certain comments and suggestions, which are based on our endeavor to interpret these data properly, will possibly be of use to your committee and of interest to others in the products field, I am sending these herewith in the form of an open letter.

We have plenty of evidence to indicate that concrete building units, on the whole, are regarded with suspicion by many city building departments, and the reason for this undoubtedly is that so many poor products are in evidence. It is not that the building officials are unreasonable and do not recognize that perfectly good concrete units can be made, and *are* made, but they do not care to assume the burden of accepting something which has a low batting average, so to speak, something which may keep them in a state of worry unless they are constantly checking it up. They are absolutely right in this attitude, and they are right in looking to the industry to find itself, get itself organized, weed out its incompetent elements, and take such steps as will insure the turning out of a uniformly good product.

I presume that the majority of the members of Committee P-1 had the same point of view, and that they felt that the quickest way to get adequate recognition of concrete building units was to recommend a single high standard of quality. They recognized, of course, that a graded requirement would be more logical if it could be properly enforced, but the argument was, if I understood the discussion correctly, that there would be no practical way of distinguishing between various classes of units on the job except by constant inspection and testing.

On the other hand it seems to me that in these times when buildings of all kinds, and particularly small houses, are so much needed, and when the costs of material and labor are so high, we should do what we can to encourage building as efficiently and as economically as possible. We are not doing this, however, if we demand blocks and tiles, everyone of which must have a load carrying capacity of more than 70 tons per square foot. It is not reasonable nor fair, either to producers or users, to insist on this quality of unit for every house, garage or partition wall that has to be built.

There ought to be a way out of this difficulty, and I believe the way lies in the adoption of graded requirements for compressive strength based on gross area as suggested by the minority of Committee P-1, with some provision that will automatically take care of the class of any individual unit. The minority report suggested four classes of block and tile, viz: heavy bearing, medium bearing, light bearing and non bearing. The principle here is unquestionably right, but I would modify the suggested limits slightly and offer the following:

Class	Min. Av. Comp. Str. lbs. per sq. in. on Gross Area	Minimum Individual Test
A, or heavy bearing	1200	900
B, or medium bearing	800	600
C, or light bearing	500	375
D, or non-bearing	250	200

The only essential change from the limits suggested in the minority report is a more liberal tolerance (25 per cent) in the individual test. This is recommended on the assumption that commercial products will vary more than carefully made laboratory test pieces, and in laboratory tests we not infrequently encounter as much as 15 per cent variation from the average of similar test pieces.

Now as to the means of distinguishing between different classes of units as they come on the job. The frequently quoted Pittsburgh Code contains a paragraph which reads as follows:

"Branding—Each make or brand of concrete block for bearing walls or piers must be marked or branded and all such marks or brands together with test reports thereon as herein required must be kept on record in the Bureau of Building Inspection. Whenever, in the opinion of the Superintendent of Building Inspection, concrete block does not conform to the requirements herein contained he shall have the power to require such tests to be conducted as herein provided."

Can we not go a step farther and recommend the following:

"Each make or brand of concrete block or tile for walls or piers must be marked or branded with the manufacturer's mark, *and also with the grade or class* for which the unit is manufactured, and all such marks together with the test reports thereon as herein required must be kept on record, etc., etc."

It seems to me that this provision would be acceptable to every manufacturer who has any confidence in his process for turning out a uniform and dependable product, that it would remove the last reasonable objection on the part of city building departments, by removing any question of what class any unit belongs in, and that it would do more than any single thing to protect the industry against the damage done by the back-yard type of manufacturer who knows nothing and cares nothing about making a decent product.

I realize that the suggested requirement belongs in a set of building regulations rather than in a specification, but the provision is so important that it ought not to be omitted from the specification—let it go in as a footnote if there is no other way. The thing to be borne in mind right now is that a specification having the approval of the American Concrete Institute will encourage a lot of building departments to formulate reasonable building requirements for concrete units, and any suggestion which the specification can carry that will help the code writers to see how they can distinguish between different classes of good units and keep out the poor ones will certainly be acceptable to everybody concerned. There is, of course, a great deal more work to be done before the data are available on which model building regulations can be drafted, but we should not lose sight of the fact that reasonable and adequate specifications for concrete units must be drawn and approved by the Institute at the earliest possible moment in order that these may be used as the basis for code requirements.

Turning now to the absorption requirement, I should like first to express the personal opinion that the absorption test might well be done away with entirely for any kind of a building unit, on the ground that it not only furnishes no dependable information, but also is very frequently misleading. Generally speaking, high absorption and poor quality go together, but poor quality is just as well, and in fact more certainly, indicated by low compressive strength. On the other hand, a very good product may have a high absorption. This was illustrated by a recent test in our laboratory of a well known type of 8 in. by 8 in. by 16 in. block, 30 per cent air space, which taxed the capacity of our 300,000 pound testing machine. The ultimate load was 291,000 lbs. giving a crushing strength on gross area of nearly 2300 lbs. per sq. in., or 230 per cent of the required strength according to the Institute Standard No. 10. The block failed, however, to meet the 10 per cent absorption requirement of this same Standard. It is a pity if a unit of this character, which is well made, and in every way acceptable, has to be thrown out because the manufacturer, in his determination to make a first class unit, used *too much cement* and too small a proportion of course aggregate.

> "In these times when buildings of all kinds, and particularly small houses, are so much needed, and when the costs of material and labor are so high, we should do what we can to encourage building as efficiently and as economically as possible. We are not doing this, however, if we demand blocks and tiles, everyone of which must have a load carrying capacity of more than 60 tons per square foot. It is not reasonable nor fair, either to producers or users, to insist on this quality of unit for every house, garage or partition wall that has to be built.
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> "There ought to be a way out of this difficulty, and I believe the way lies in the adoption of graded requirements for compressive strength based on gross area: heavy bearing, medium bearing, light bearing and non bearing.

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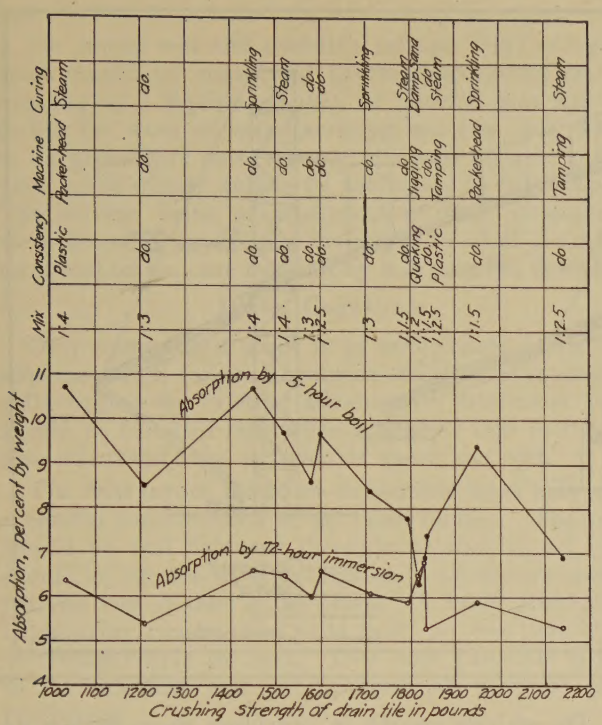
In connection with our studies of the alkali problem



Relation of Crushing Strength to Absorption

in the West, quite a large variety of cement drain tiles were manufactured not only of different mixtures, but on different machines and with different curing treatments. The crushing and absorption tests on these tiles were reported in Bureau of Standards Technologic Paper No. 214, Appendix A, page 492. I have taken all the results from the table there given that are directly comparable, and in the accompanying diagram have plotted percentage of absorption against crushing strenth of the tile. It will be noted that there is a tendency, only, for the absorption to diminish with increasing strength, and that in general there is no dependable relation between absorption and quality as indicated by richness of mix or crushing strength. It is seen also that very large, and sometimes erratic differences occur in the absorption as determined by different methods, and a still wider range of results would be expected if a proposed method of exposing a single surface of the specimen under test were employed.

The point of all this is that we have no interpretation to place on the absorption test at the present time. We have considerable evidence to show that a permeability test would, in combination with the strength test, give an indication of durability and resistance to disintegrating forces, but the present status of investigative work along this line does not afford enough data to warrant any radical change in the absorption requirements. If, however, we assume that the absorption test is to be retained for what meagre information it furnishes in regard to porosity and durability, why do we need to apply it as a restriction upon building units that are not directly exposed to soil, or weather? For interior partitions, or for exterior walls which are to be covered with stucco or otherwise adequately protected, a higher absorption than 10 per cent is often desirable. Many units of adequate strength will serve their purpose better, both in the process of laying and in the functions they have to perform in the built up structure with somewhat higher absorption.

I would, therefore, suggest to your committee that, in view of what we know and what we do not know about the value of the absorption test, a fair compromise between present requirements and no requirements at all in regard to absorption would be the following:

"The absorption of concrete block or tile which are to be exposed directly to the weather or to sub-surface conditions shall not exceed 12 per cent of the dry weight of the unit when tested as herein specified."

The way in which the absorption test is to be carried out is important if there is a definite specification limit, and the simplest way to insure uniform practice is to dry out the entire unit at a temperature between 220° and 230° F. weigh it after it has cooled to atmospheric temperature, and then submerge it for 48 hours. Provision should be made, however, for allowing an absorption test on a piece of the face wall of a block or tile that is not cracked or otherwise injured in cutting or detaching from the rest of the unit. The reason for this is simply one of convenience, as it is quite a task to perform the required operations on a large, heavy unit.

To express the purpose of this letter in a few words, I hope your committee will recommend for adoption at the coming meeting of the American Concrete Institute a specification for concrete block and tile based on graded requirements as to compressive strength, and containing an absorption requirement which will not arbitrarily restrict or prevent the use of such units where experience has shown them to be entirely satisfactory.

Very truly yours,
J. C. Pearson
Chief, Cement Section
United States Bureau of Standards.

Painting Concrete Surfaces

The principal drawbacks to successful painting on cement or concrete have been pointed out as moisture and free lime. The former is believed to cause blistering and peeling, and the latter to destroy the oil in the paint. Since free lime is gradually neutralized by exposure to the elements, unless it is necessary to paint immediately, cement surfaces present more favorable painting conditions if exposed for a year or so.

Concrete floors, however, cannot be subjected to the same conditions as exterior surfaces, and satisfactory painting results can be expected only after other possible efforts have been made to neutralize the free lime and to eliminate moisture. The elimination of moisture is not always possible, especially in garages and factories where they are poured directly on the ground. The moisture is drawn back for some time through the floor by the warmer atmosphere.

Further information on this subject, according to the research department of the Bass-Hueter Paint Co., quoted in *The Architect and Engineer,* states that ordinary varnishes or sizes have no neutralizing effect whatever on cement or concrete surfaces; the action is purely of a physical nature. In view of these facts, it is always advisable to eliminate as far as possible moisture and to neutralize the free lime. The proper application of a coat of about 8 oz. of zinc sulphate crystals dissolved in one gallon of water has been found most satisfactory for the neutralizing of the lime. The solution is applied freely to the surface with a large brush, and allowed to dry thoroughly before the application of the finishing coats.

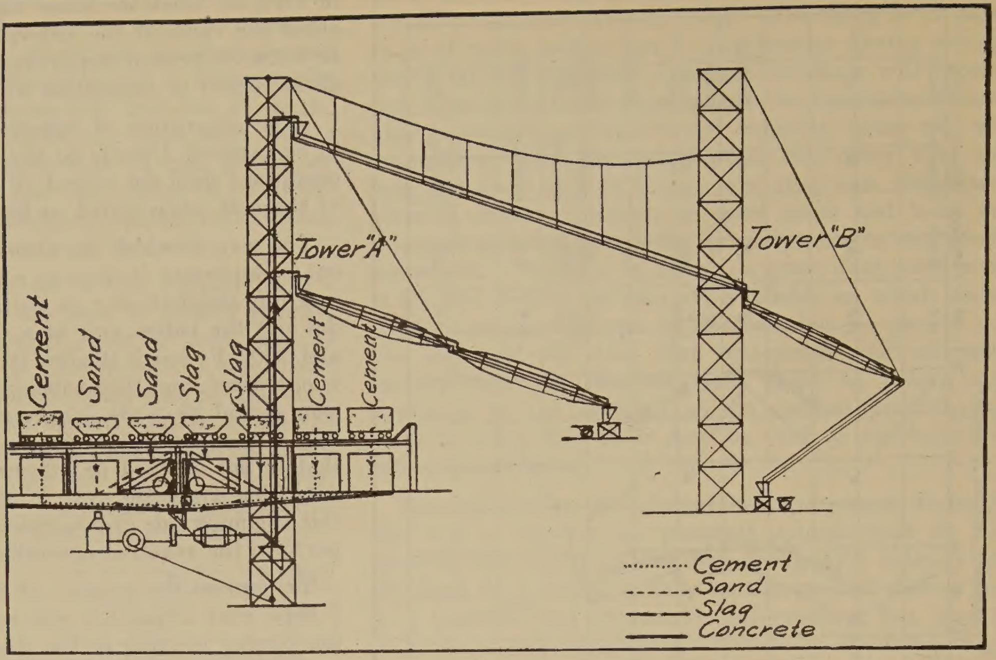


FIG. 2—DIAGRAMATIC ROUTING OF MATERIALS

A Plant Layout—Saving of 36% Equipment Cost[1]

BY RICHARD P. WALLIS
THE LUNDORFF BECKWELL CO.

The success or failure of a construction operation depends in no small manner upon the layout and equipment of its concreting plant. By the concreting plant is meant the mechanical equipment for receiving, storing, mixing and depositing the materials that constitute the concrete frame of the building.

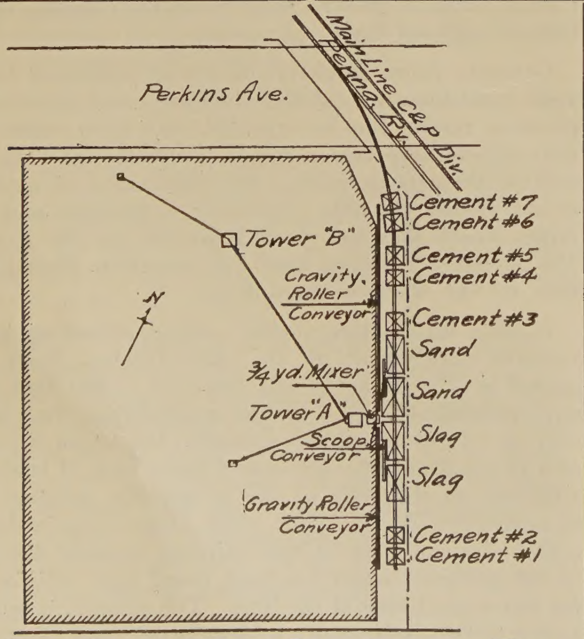


FIG. 1—DIAGRAM SHOWING PLANT LAYOUT ON WARD BAKING CO. BUILDING

The objects sought in providing these devices as a substitute for human labor in the carrying on of these operations are to increase the speed and to reduce the unit cost of preparing and placing this concrete. These requirements constitute the criterion by which the performance of the plant is judged.

As practically each building operation is unique in its character, so may we expect to find separate and distinct problems to solve in meeting individual job requirements. There are, however, two fundamental principles that are common to all efficient plant layouts. In the first place, the continuity of supply must be guaranteed against interruption, so as not to jeopardize the successful placing of the concrete; furthermore, the force of gravity should be employed wherever possible to convey material from one location to another.

FACTORS INFLUENCING EQUIPMENT SELECTION

The special factors that influence the selection of equipment are as follows: First, the nature of the material to be handled; second, the source of supply and method of transportation; third, local physical conditions; and, fourth, the initial cost and probable salvage value of such equipment.

The equipment decided upon must be well adapted to the purpose for which it is intended. Cement in bulk requires one type of conveyance, while in sacks it must be handled by other means.

The source of supply and method of transportation exercises a considerable influence in the choice of this equipment. If the aggregates are obtained from local sand and gravel banks, special washing and screening apparatus will be required as well as excavating equipment. If brought to the site by water, rail, or truck, unloading devices must be provided that will function in a satisfactory manner in each case.

The arrangement of the buildings, their height, the quantity and distribution of the concrete to be placed, and the amount of available storage space must be considered before deciding on any particular layout. Existing rail or dock facilities must be investigated, as well as the topographical features of the site. The plant layout must be shaped to profit by any special physical condition that may exist at the start of operation.

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[1] From the *Constructor*, of Associated General Contractors of America.

The initial cost and probably salvage value of equipment should be considered before determining on the final layout. Equipment may be selected that will expedite the work of manufacturing concrete, yet, owing to its prohibitive cost, increase the unit costs to such a point as to wholly nullify its usefulness in that respect. The salvage value of equipment of this character is variable and depends upon the original cost of the equipment and on the care received by it during the operation.

DON'T OVEREQUIP

Over-equipping a plant is as unfortunate in its consequences as is failure to provide sufficient equipment to fully utilize the existing advantage. Additional plant should be installed only when it is clear that such addition will satisfy the criterion of speed and cost.

The final layout should be determined upon only after a careful consideration of all these factors. The plant should be well balanced throughout—that is, all parts should be selected so as to function in an efficient manner without loss of time or materials. A basic principle of engineering construction is to make no one part better or stronger than the rest. This same principle applies to the selection and arrangement of concrete plant equipment.

A MODEL PLANT LAYOUT

The plant layout in the new building now under construction by the Lundorff-Bicknell Co., for the Ward Baking Co., at Forty-sixth street and Perkins avenue, Cleveland, contains numerous interesting features and admirably illustrates the application of many of the above principles to a typical plant layout.

The building itself covers an area of 260 ft. by 315 ft., and varies in height from 20 to 60 ft. The floors of this building are of reinforced concrete, designed as flat slabs averaging 7 in. in thickness, and carried on heavy concrete columns. Altogether, including floor, columns, foundation, etc., there are approximately 10,000 cu. yds. of concrete in the finished structure.

The building is located in a built-up district of the city and occupies approximately 70% of the entire lot. This limitation of available storage space necessitated a careful preliminary study of the possibilities offered by the use of mechanical equipment in the efficient handling and placing of this concrete.

Fortunately there existed at the start of operation an 18 ft. wood trestle along the entire east side of the property, carrying a single track spur from the main line of the C. and P. division of the Pennsylvania Railway. The entire plant was planned and erected with especial reference to the use of this track in the delivery of materials.

Sand, slag, stone, and sacked cement are brought to the job in carload lots. The bottom-dump cars are spotted on the trestle over the respective bins and sheds, and their contents unloaded by gravity. The aggregates are dumped through the hoppers to their respective bins, while the cement is dropped directly down through chutes to the various sheds below.

Power for shifting these cars locally by means of a cable and nigger head located at one end of the trestle is obtained from the same 75-h. p. McMyler boiler that operates mixer, hoist, and pumps.

STORAGE

As will be noted from Fig. 1, there are two sand bins, each with a capacity of 150 cu. yds., and two slag bins, of similar capacity. It was found necessary to build twin bins for both sand and slag owing to lack of sufficient height beneath the trestle for a single bin with a storage capacity adequate for a day's continuous pouring. This arrangement was made possible by the use of two power-driven Jeffery belt conveyors that elevate the material from the outer bin in each case to that adjacent to the charging hopper. These conveyors are operated by 5-h. p. electric motors, and have a lifting capacity of approximately 1 cu. yd. per minute.

There are 7 cement sheds, with an average capacity of 950 sacks (one carload) each. Sheds No. 1 to No. 6, inclusive, are for daily use, while shed No. 7 is held as a reserve in case the unexpected happens and the supply of cement is interrupted. Carload lots of cement are not used until after the report of the seven-day test has been received. Until then a sign bearing on one side the words "Do not use" is placed on the door of the shed containing that particular carload. Upon approval this is reversed to read "O. K." and the cement is ready for use.

MIXING

The material from the inner bins is admitted directly to the charging hopper of the mixer, which is located in a pit directly between and below these bins, through steel cut-off gates operated by hand. This charging hopper is divided into two portions by a vertical partition, so that the proper amount of sand and slag for each batch is easily determined by filling each portion to the proper level. The cement is brought to the charging hopper from the various sheds by Mathews gravity roller conveyors. Wood pallets with a capacity of 3 sacks each (enough for one batch) are provided for this purpose. The empty sacks are shaken, counted and tied in bundles of 50 each, and are stored near the cement sheds for ultimate return to the mill.

Water is supplied from city mains and is measured by means of a tilting barrel conveniently located on the mixing platform. The flow of water is controlled by means of a quick acting valve located at the barrel. The charging hopper, when filled with the proper charge of material for the batch, discharges into a ¾-yd. Smith tilting mixer, operated by an Orr & Sembrower 10 h. p. vertical engine geared direct to the mixer and supplied with steam from the main boiler, where it is properly mixed.

DISTRIBUTION

The batch is discharged into the hoist bucket and elevated in the main tower "A" a distance of approximately 150 ft. to a receiving hopper. A 10-in. by 10-in. single drum McMyler mine hoist is used for hoisting the concrete. This main tower has a second receiving hopper located part way to the top, which, as the work progresses, may be raised by means of a winch located at the tower base. This latter hopper discharges into a floor hopper through a 100-ft. section of Lakewood trussed steel chute, jointed in the center and supported from the tower by steel cables, which is used to deposit concrete to the area immediately adjacent to the mixer. The concrete from the top hopper is spouted to a second receiving hopper in tower "B," some 15 ft. distant, by means of a line chute with a fall of 4 in. to the foot, supported by block and tackle from a steel cable strung between the two towers. It is then distributed to the various locations by means of an adjustable section of chute 100 ft. long, jointed in the center and supported by cables from the top of tower "B." Lakewood chutes are used throughout in this equipment; these are semicircular in section and have a radius of 7½ in. Swivel joints and splash hoods are provided where necessary to insure the flexibility of the operation and to prevent loss of materials.

The towers are of wood, 9 ft. square, and are built of 6-in. by 6-in. posts, 2-in. by 10-in. ledgers and 2-in. by 8-in. cross braces, all securely spiked together in 7-ft. bents and well guyed.

Daily Plant Capacity 350 cu. yds.

As the specifications state that all concrete must be placed by hand, floor hoppers supported on platforms are provided at the end of each chute for loading the concrete into buggies. The layout calls for a maximum distance of 150 ft. that concrete must be buggied.

This plant is designed with the idea of mixing and placing a maximum of 350 cu. yds. of concrete per eight-hour day. To supply the necessary amount of materials for this quantity of concrete, there are required about 195 cu. yds. of sand and 300 cu. yds. of slag. This is the approximate capacity of the combined bins, so it is necessary to restock the bins at least once a day during the interval of continuous pouring. The cement sheds have a total capacity sufficient for from four to five days' continuous run at maximum capacity. The railroad company makes two switches a day, which is sufficient to keep the bins well stocked at all times.

Provision is made for preheating the sand and slag during freezing weather, by means of steam coils inserted in the bins and supplied by the same boiler that furnishes steam to the hoisting engine and mixer.

Costs

It is estimated that through the use of this plant equipment the cost of stocking sand and slag has been reduced to approximately 3 cents and 4 cents per cu. yd., respectively, and that cement is handled for approximately 7 cents per barrel. Handling, mixing and placing costs for this concrete are in the neighborhood of 90 cents per cu. yd. This cost is somewhat higher than it would be were it possible to spout the concrete directly into the forms.

Five laborers are used to operate this plant back of the mixer, one tending the water, one each at the sand and slag shut off gates, and two handling the cement. Two engineers are required, one at the mixer and one on the hoist. There is also one laborer in the pit to keep it clean, while another is stationed in each tower during pouring, to regulate the flow of concrete through the hoppers and chutes.

The use of this equipment does away with an additional force of 15 laborers behind the mixers, who would otherwise be engaged in handling the concrete materials. This means a saving of $90 a day for an equivalent of 40 days' continuous pouring, or a total of $3,600. As the total cost of the equipment, exclusive of possible salvage, is in the neighborhood of $10,000, this saving alone represents 36% of the equipment cost. This saving is equivalent to 36 cents a cu. yd. of concrete. The cost of this equipment per cu. yd. of concrete is approximately $1.00.

Speeding Up Chicago Apartment Construction

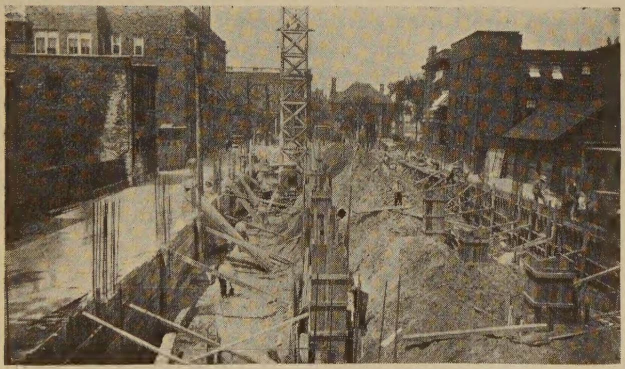


Fig. 1—Sheridan Surf Apartment Building—Material Bins Were Built Along Wall at the Left

In building the Sheridan Surf Apartment building in Chicago it was necessary for the contractors to adopt special methods for handling the materials. The building is 246 ft. long and 53 ft. wide. It fronts on Sheridan Road, which must be kept open for traffic all of the time. This made it necessary to handle all of the materials in the alley that runs the entire length of the building .

Along this alley, in the basement of the building, a line of bins was constructed. A concrete foundation extends along the alley at a height of 1½ ft. The trucks run into the alley, then back against this foundation, and dump their loads of gravel or sand directly into the convenient bins. From these bins the materials are taken into industrial cars or batch boxes which run on a narrow-gauge track. A boom derrick attached to the concrete tower picks up these cars and they are dumped directly into the mixer. The same hoisting engine that operates the concrete hoist also picks up these boxes.

To provide space for these bins, part of the first floor was temporarily left open, as shown in Fig. 2. Girders and floor slabs are to be inserted later.

One novel feature is a large wooden trough that has been made for this job. Into this trough is placed the cement for one batch. The trough is supported on wooden rollers. For dumping into the hoper of the mixer, the trough is simply pushed forward until it dumps itself.

Construction work is being done by Schmidt Bros. Construction Co., Chicago, Ill.

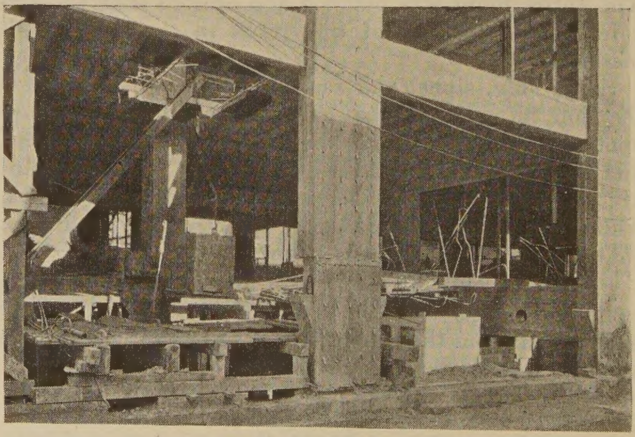


Fig. 2—View Showing Arrangement for Dumping from Alley—Wooden Trough for Handling Cement Is Shown in the Shadow Near the Base of the Pillar

Lining Queenston-Chippewa Power Canal

By Roderick B. Young
Senior Assistant Laboratory Engineer
Hydro-Electric Power Commission of Ontario

In lining the hydraulic canal of the Queenston-Chippewa development of the Hydro-Electric Power Commission of Ontario, over 540,000 sq. yds. of concrete lining were required. This necessitated placing 302,650 cu. yds. of concrete, the greater part of which had to be put in in about nine months. For this, special equipment and methods were developed which it is the purpose of this article to describe.

The Queenston-Chippewa development diverts around the Canadian side of Niagara Falls a flow of approximately 15,000 sec. ft. The flow of the Welland River is reversed for four and one-half miles, after which the water is carried through a canal excavated in earth and rock to a power house at Queenston. The initial installation has a capacity of 275,000 h. p., while the ultimate capacity of the development will exceed 550,000 horsepower.

The canal is 8½ miles long, of which seven miles is in rock with earth overburden. The rock excavation reaches a maximum depth of 85 ft., while the maximum depth of the canal is 145 ft. The finished section of the canal is 48 ft. wide. The bottom is paved with a 9-in. slab of concrete, and the sides surfaced with concrete to an average height of 34 ft.

After the canal had been excavated the sides were scaled from traveling scaling plants, so that no rock would project nearer than 6 in. to the finished surface of the concrete. The spoil resulting from this operation was removed and two 15-ft. strips of pavement were placed one on each side of the canal. The side walls were then placed from traveling lining plants. Behind these the remaining middle strip, 14 ft. wide, was paved either directly from a paving plant, or by concrete wheeled from a lining plant.

Before concreting could proceed preliminary operations of some magnitude had to be carried out. The rock forming the floor foundation and the backing of the lining was seamy, and water bearing, and the disposal of this water required that, at times, the pumps handle over fifteen million gallons per day. To provide drainage for this water, a concrete pipe line was laid below grade along the middle of the canal bottom. Sumps were opened and pumps installed at intervals of about 1,000 ft. Wherever there was noticeable flow through the rock, the seams were opened, then bulkheaded with planks and the water led from behind the bulkhead through a small pipe in the rear of the steel forms extending to floor level.

Paving plants were used only during the early part of the work. These paving plants traveled on tracks laid down the center of the canal. They were equipped with electrically driven 28-S mixers, discharging into a chute arranged to distribute concrete to either side of the canal. The mixer was fed from small overhead bins, while cement was supplied from the service track above. A view of one of these plants is shown in Fig. 1.

Since these paving plants had a limited storage capacity, efficient operation required that materials be supplied at frequent intervals. As concreting plants which had to be supplied from the same service track were added, this was found somewhat difficult to arrange. Eventually the paving plants were discontinued and the paving for both the sides and center was placed from the lining plants by means of runways and buggies.

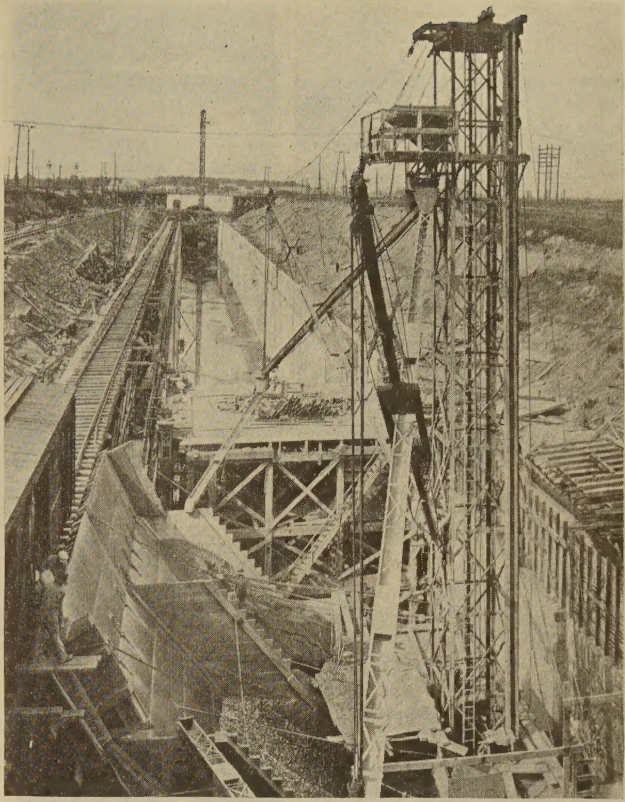


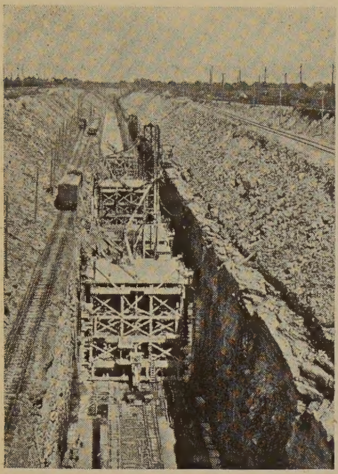
Fig. 1—Mixing Plant and Rear Form Lining Canal and Building Retainig Wall

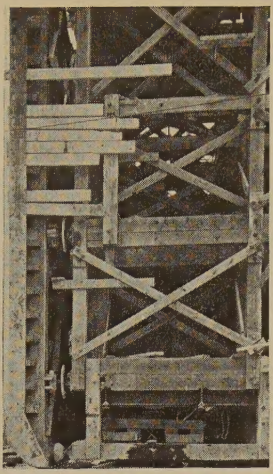
The lining plants were more elaborate structures. Each plant consisted of three units, a mixing plant and forms units front and rear. Each unit was mounted on special trucks and traveled on two tracks, one on each strip of the pavement previously placed. Moving was accomplished by means of tackle attached ahead to heavy pins set in the rock bottom, the moving power being supplied by the mixer hoist.

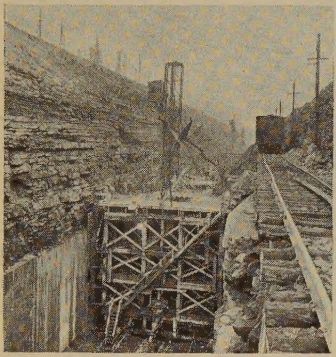
The lining plants were specially designed by the engineers of the Commission to meet the requirements of this work. From a central structure, steel forms were suspended, one from each side, each form being hung from two 75-ton jacks mounted on rollers, which allowed a small lateral movement of the form. Twenty-four screw jacks, operated by hand wheels, held the form in place and drew it back from the concrete on the completion of a section.

Each form was 34 ft. high, 40 ft. wide, and weighed 50 tons. It was made up in six sections, a base panel 4 ft. high and five movable panels each 6 ft. high. The base panel was shaped to form the bevel at the bottom of the side walls. The movable panels could be raised so that spading operations for each 6 ft. lift might be carried on by working between the panels. The panels were raised and lowered by means of rods suspended from winches at the top of the structure, as is shown in Fig. 6.

The structure supporting these forms was very ruggedly built of steel beams and heavy timbers, and was designed to take care of the dead weight of the form panels, the heavy stresses due to moving and the thrust from a full head of liquid concrete. The top was floored over and through this flooring five openings were provided on each side for concrete hoppers, which dis-







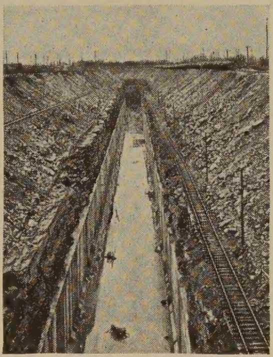


Fig. 2—(Upper Left) Lining Plant Placing Alternate Forms, Followed by Second Lining Plant Placing Intermediate Forms

Fig. 3—(Upper Right) End View of a Bulkhead Form, Showing Method of Placing Bulkhead Strips and Jack Screws Used to Strip Form

Fig. 4—(Lower Left) Rear View of Lining Plant, with Top Panels Lifted to Permit Spading

Fig. 5—(Lower Right) A Section of Completed Canal

charged into flexible drop chutes reaching to the bottom of the forms. A stairway extended from top to bottom and gave access to platforms at intermediate levels, from which the concrete was spaded.

Certain of the forms—those which placed the pioneer sections—were fitted with bulkheads. Parallel steel strips 15 in. wide were fastened at both ends of each form to the beams carrying the panels, and between these strips were bolted 2-in. planks having their ends cut to fit the irregular rock surface. By caulking any opening left between the rock and the plank, a tight bulkhead was obtained, which was economical in material and required little labor to set and adjust.

The mixing plant was a separate unit distinct from the forms. It carried a centrally divided overhead bin of 100 cu. yds. capacity, a 28-S mixer and hoisting equipment, both electrically operated, a 95-ft. steel tower, and storage space for one car of cement. Those plants in operation during the winer of 1920-21 were also equipped with a boiler to supply steam for heating the aggregates and curing the concrete. The tower was fitted with steel booms, one on each side, from which were hung counterweighted chutes. The chutes were set at a slope of one vertical to 2½ horizontal.

Cement was brought to the plants in car lots. It was unloaded by hand into rectangular wooden chutes, which carried it from the level of the service track to the cement storage below. Because of the steep angle of these chutes, special provision had to be made to prevent breakage of the bags. The chutes were of narrow section and pinched the bags, while weighted planks were fitted into the chutes in such a way that the descending bag must lift the plank.

Sand and crushed rock were supplied to the mixing plants from a service track along the edge of the rock. Standard 20-yd. cars, divided into two compartments, one for sand, the other for stone, were side-dumped into the divided bin of the mixing plant in the canal below. The bin was fitted with a hinged apron, which was laid against the side of the canal and on which the aggregate fell. By this means the aggregate was successfully handled even where the service track, because of the depth of the canal, was over 40 ft. above the top of the bin. Water was supplied from a pipe line, paralleling the canal, and was measured at each mixer by means of an open-top barrel fitted with an adjustable overflow.

In lining the canal the first operation was that mentioned before, namely, laying the two side strips of paving. Alternate panels of the side walls were then constructed, the intermediate panels placed and finally the center strip of paving laid.

In placing the side walls two different combinations of form and mixing units were used. Where possible a mixing unit with two form units fitted with bulkheads worked ahead and placed alternate panels, and where a paving plant was not used, placed the side strips of pavement. This plant was then followed by another plant having form units without bulkheads, which placed the intermediate panels and laid the center strip of pavement. In other places the plants consisted of a mixing unit preceded by a form unit fitted with bulkheads and followed by a form unit without bulkheads. The disadvantage in this arrangement was that the mixing plant

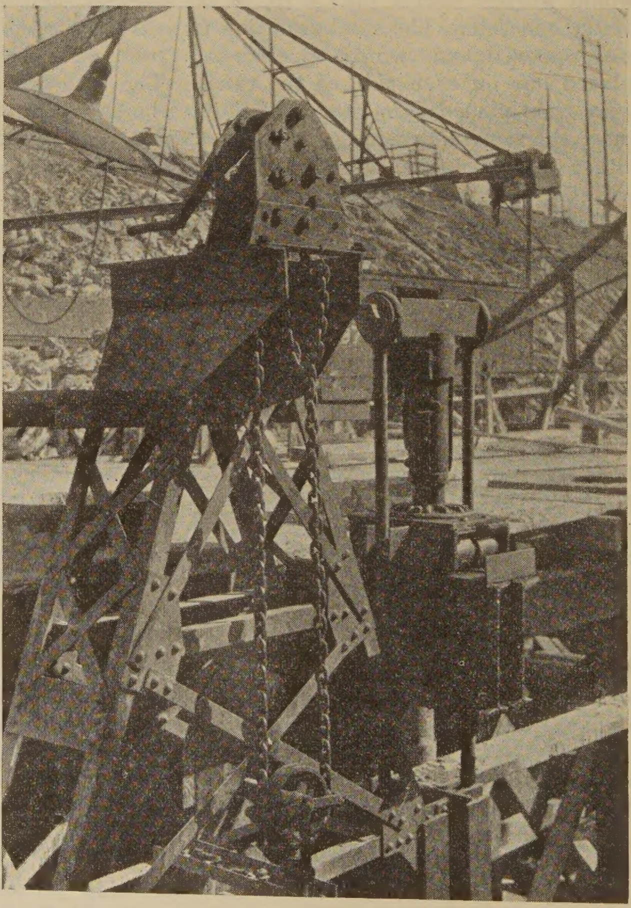


Fig. 6—One of the Jacks Supporting Form with Winch, Which Raised and Lowered the Sliding Panels

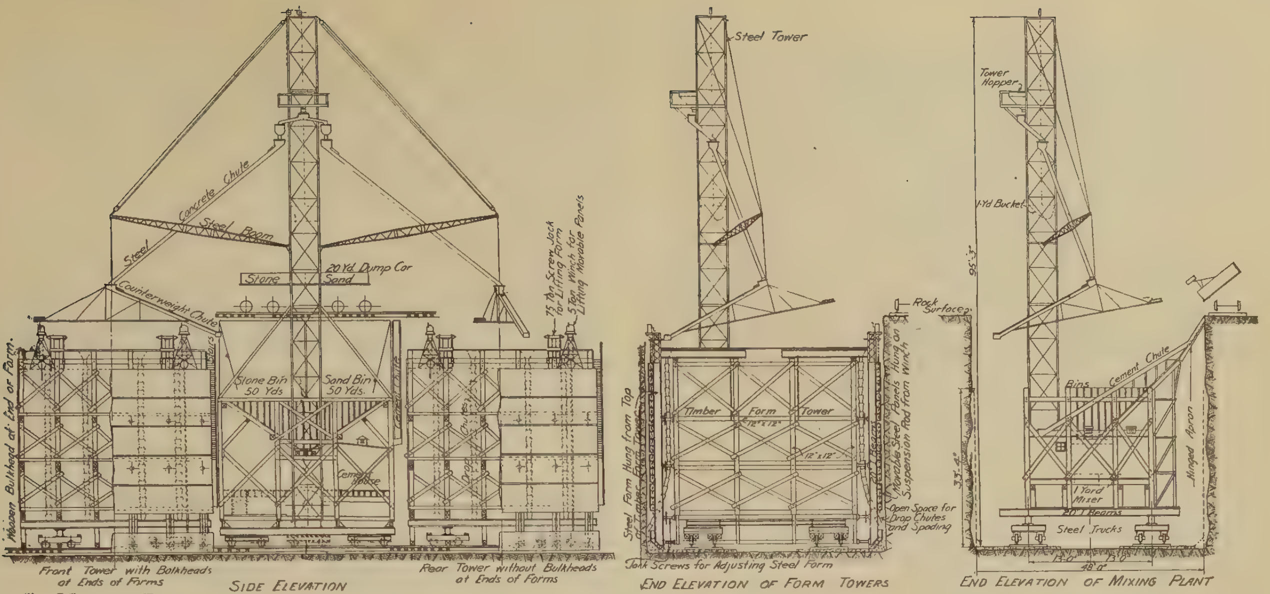

Steel
Concrete Chute
Steel Boom
20 Yd. Dump Car
Stone
Sand
Counterweight Chute
Stairs
Stone Bin 50 Yds
Sand Bin 50 Yds.
Cement Chute
Cement House
Drop Chute
75 Ton Screw Jack for Lifting Form
5 Ton Winch for Lifting Movable Panels
Wooden Bulkhead at End of Form
Front Tower with Bulkheads at Ends of Forms
Rear Tower without Bulkheads at Ends of Forms
SIDE ELEVATION
Steel Tower
Rock Surface
Steel Form Hung from Top of Timber Form Tower
Timber Form Tower
12" x 12"
12" x 12"
20" I Beams
Movable Steel Panels Hung on Suspension Rod from Winch
Open Space for Drop Chutes and Spading
Jack Screws for Adjusting Steel Form
END ELEVATION OF FORM TOWERS
Tower Hopper
1-Yd Bucket
95'-3"
33'-4"
Bins
Cement Chute
Hinged Apron
1 Yard Mixer
20" I Beams
Steel Trucks
13'-0"
13'-0"
48'-0"
END ELEVATION OF MIXING PLANT

Fig. 7—Mixing Plant and Movable Forms for Pouring Concrete Canal Lining

had to be moved back each time an intermediate panel was poured, while, with the other arrangement, the mixing plant would pour two pairs of panels for each move.

The quality of work obtained with these plants was excellent, the forms giving a smooth surface almost free from vertical projections, which would retard the flow of water through the canal. By constructing the form panels so that spading could be carried out, a dense concrete resulted, requiring no patching. This was obtained with relatively lean mixtures. The average proportions used on the canal lining were $1:2\frac{1}{2}:5$, with a cement content of 1.12 bbls. per yard. Concrete cylinders were taken periodically throughout the work and tested. The results were very gratifying, remarkably uniform concretes being obtained at all times.

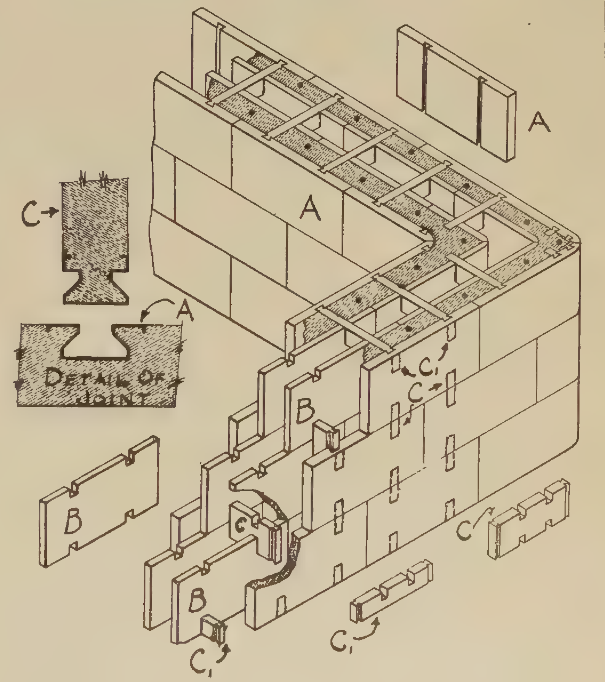
The maximum quantity required to complete a 40-ft. panel on both sides was 381 cu. yds., and the minimum 104 cu. yds. These were poured in one shift, using a 1-minute mixing period. Six to eight hours was usually sufficient to fill one set of forms. Pouring was continuous from bottom to top, both sides being brought up simultaneously. Nine of these plants were operating at one time. Concrete was usually stripped in 12 to 15 hours, and in a few cases where conditions were favorable, in nine hours. The maximum output per week for any single plant was 320 ft.; the maximum placed in one week for such plants as were in operation at any one time was 1,640 ft.

Sir Adam Beck is chairman of the Commission, for which Fred A. Gaby is chief engineer, H. G. Acres hydraulic engineer, T. H. Hogg assistant hydraulic engineer, and W. V. Sauer, engineer of design. The work was carried out under the direction of H. G. Acres, with G. H. Angell as general superintendent and A. C. D. Blanchard chief field engineer.

That the only certain remedy for the action of alkali on concrete is the exclusion of sulfate waters of high concentration from contact with the concrete, is the conclusion drawn by Prof. Thorvaldson, University of Saskatchewan, in a paper read at the general professional meeting of the Engineering Institute of Canada, Winnepeg, Man. Tried, cheap, efficient means for this are not available. Substitution of the calcium aluminates possessing cementing qualities in place of calcium silicates has led to the development of the so-called "electric cement" and "ciment fondu."

Hopkins Wall System, With Thin Precast Units

The illustration shows the hollow wall system of construction devised by Ralph B. Hopkins, Detroit, Mich. The wall consists of thin slabs of concrete, 8 in. by 16 in., held together by concrete ties. The ties fit into dovetail joints (metal covered in manufacture for accuracy in joining) in the slabs and are interjointed so as to make a very solid construction. The space between the outer and inner slabs is filled with concrete.



Perspective View of Wall According to the Hopkins System

Hollow pillars and chimneys can be constructed by this system, with slabs for each side fitting snugly at the corners and held together along the length and the width by ties shaped like a cross with wide members that fit together and form the inner wall.

Mr. Hopkins is developing an automatic machine to manufacture his units.

Joint Committee Rules for Columns

A Discussion

By C. A. P. Turner, C.E.

The hooped column, when substantially reinforced longitudinally, is the most reliable column that can be built. It has no record of failure, in strong contrast to the tied column.

The writer has made tests of hooped columns with 5% verticals and 2½% hooping, developing substantially 9,000 lbs. per sq. in. core area. With the same size column, 3% of vertical steel hooping and spiral .75%, the increased strength over plain concrete was the same per cent as with the larger percentage of steel, but the strength developed was but five-eighths as much.

If we compare this with prisms tested by Bach, having 4.6% vertical steel with ¼-in. ties, 10-in. spacing developing an average ultimate strength of 2,700 lbs., we have a fair idea of the amazing increase in strength which spiral hooping adds to the shaft.

Again, consider the Bach tests, 4.6% vertical steel with ¼-in. ties, 10 in. centers, developed 2,700 lbs. per sq. in., as an average crushing strength of three specimens, while a reduction of the vertical steel to 1.14% with the ¼-in. ties increased four times, or to 2½ in. spacing, gave an average ultimate strength of 2,915 lbs. per sq. in. A little addition to the metal of the tie increased the strength of the prisms a far greater amount than 3% vertical steel. The absurdity of putting in ¼-in. ties 8 in. on centers in a 20-in. column, with 5% of steel, is a close approach to the performance of the Cleveland contractor who economized on hooping by using hay wire for ties, with the result that the building collapsed before it was completed, with loss of life to parties in adjacent premises, followed by the customary suits for damages all around. The writer would recommend a modification of the tentative specifications so that it would not so strongly resemble the characteristics of hay wire tie construction.

The make-up of the column formulas in the tentative specification reverse sound theoretical principles. Rational specifications should favor the safer construction by economically penalizing the types that are hazardous during erection. This principle is wholly disregarded and reversed by the Committee's tentative specification.

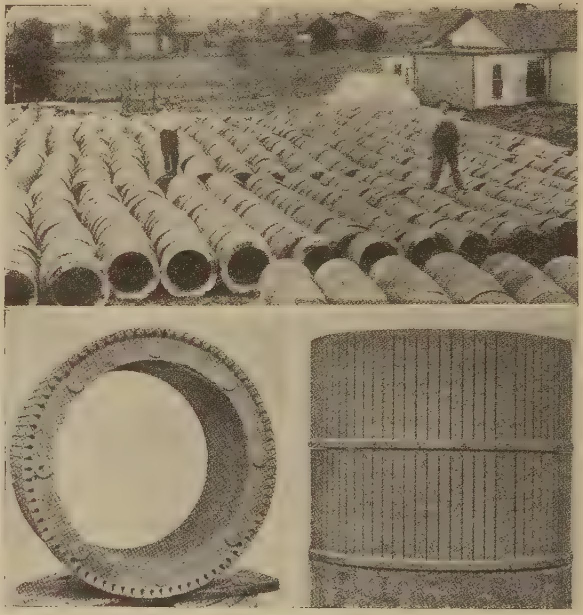
The derivation of the Committee's formula appears grounded upon an erroneous conception of the nature of the shrinkage of concrete in the process of curing. Concrete resembles timber in this respect, that when wet its crushing strength is decreased 10% to 25%. In drying out in the process of crystallization, concrete, like the wet piece of timber, shrinks as it cures and dries out. Like timber, again, it grows harder and stronger, but to an enormously greater extent than timber, as it dries, and the way the plumbers swear about it who have to dig through it after it is five to six years old, is convincing proof of their appreciation of the fact. And yet our Concrete Committee has undoubtedly mistaken shrinkage for plastic weakness, and reduced the ultimate and reasonable working stress for the most reliable, conservative and economical type of concrete column because of the Committee's unfortunate failure to clearly understand the matter. The writer regards it as unfortunate, because the huge fire loss in the United States and Canada is almost sufficient to build a Panama Canal every year or two, and yet our Committee would increase this loss by suggesting unreasonably low working stresses for the safe concrete column, and at the same time permit working stresses on a vertically reinforced column that are dangerously unsafe with the percentages of vertical steel and hooping permitted under the Committee's rules and recommendations.

Concrete Well Screen

A concrete well screen which does not have the objectionable features of rusting, rotting, sand jamming, crushing, high maintenance costs and restricted water-carrying capacity common to many types, is being manufactured and marketed by the Kelly Well Co., Grand Island, Neb.

The screens are made with walls 3 in. thick and of varying diameters. The sections are 1 ft. long for all diameters. The development is described in *The Concrete Builder.*

Near the outside surface of each section are keystone shaped perpendicular grooves, approximately 1 in. deep and running to within 1 in. of the top of the section. The shape of these grooves gives a very narrow opening for the water to enter the screen, but ample room to flow down to the joint once it has entered. The horizontal joints between the sections are so designed that they fit together closely on the outside, but are open on the inside to allow the water to flow freely into the well.



Kelly Concrete Well Screens

Before placing the concrete screen in the well a metal casing is sunk to the required depth, the concrete screens and curbing strung on cables through holes provided for this purpose in each section and lowered into the well. The metal casing is then removed and the space outside the concrete screen filled with coarse sand and gravel.

The screens are usually placed in the bottom of the well and the solid curbing at the top. In several installations this company found different strata of water, but were able to locate the screens so that the objectionable water could be kept out of the well.

Kelly well screens are being used by a number of municipalities throughout the middle west, as well as by a number of irrigation projects in western Nebraska and eastern Colorado.

Tests to Determine Distribution of Stresses in Flanges of T-Beams[1]

By W. A. Slater
Engineer Physicist, Bureau of Standards

The results of various tests on T-beams have a direct bearing on current practice in the design of similar reinforced concrete members. For the purpose of comparison, the term "isolated beams" is considered as designating the sort of structure described in the tentative report of the Joint Committee, as "beams in which the T form is used only for the purpose of providing additional compression area."

Beton und Eisen, for January 5, 1922, contains an interesting discussion by C. Bach on results of tests made on broad-flanged T-beams. The tests discussed are from two investigations. The first tests were on beams of the cross section shown in Fig. 1. The span of the beam was 3 meters (approximately 9 ft. 10 in.). The loads were applied at the one-third points of the span. The cross reinforcing bars shown in Fig. 1 were spaced 10 cm. (approximately 4 in.) apart.

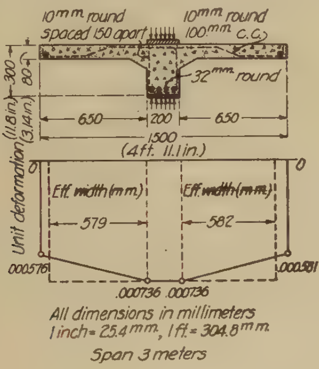


Fig. 1

Measurements of the compressive deformations on the upper surface of the flange were made at the center of the span over the edge of the stem of the beam and at the two extreme edges of the flanges. The deformations at these places under load of 30,000 kg. (about 66,000 lb.) are shown in the lower part of Fig 1 directly below the points at which they were observed. The deformations at the two edges of the flanges were 21 and 22% less than those within the width of the stem. These tests were carried out at the Stuttgart testing station, Germany, in 1911 and a more complete report is given by Bach and Graf in Hefts 122 and 123 of *Mitteilungen über Forschungsarbeiten auf dem Gebiete des Ingenieurwesens* (1912) published by *Verein Deutscher Ingenieure.*

As a rule where the T-beam form of construction is used the flange extends over several ribs and more recent tests have been carried out on specimens of that type to see if the behavior was different in the flanges between the ribs from that in the outstanding flanges. The span was the same as in the beams described above, that is, 3 meters. The load was applied within the width of the stem in equal amounts at each of eight points of the span, thus approximating a uniform load. The cross reinforcement bars shown in the flange in Fig. 2 were spaced 15 cm. (about 6 in.) apart. All measurements of deformation on the upper surface of the flange at the center of the span were taken over the edges of the stems, at the extreme edges and at the center of the top flange. The unit deformations are shown in the lower part of Fig. 2. As in the previous tests the deformation at the edges of the outstanding flanges were considerably less (average 18.5%) than that over the stem but the deformation in the flange midway between the ribs was only about 1.7% less than that over the ribs. This represents the case most commonly met in practice, but it is sugested in the article in question that the conclusion is not known to hold except for beams of the construction shown in Fig. 2. It is stated that a more complete report of these tests will be given in the future number of the *Forschungsarbeiten auf dem Gebiete des Ingenieurswesen.*

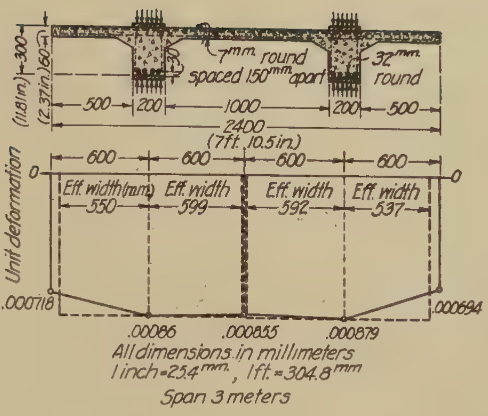


Fig. 2

Fig. 3 reproduced from Bulletin No. 64 of the University of Illinois Engineering Experiment Station, page 81, represents results obtained in the test of the floor of the Turner-Carter Building, Brooklyn, N. Y. in 1911. The span center to center of girders into which the test beam framed was 19 ft. 6 in. The distance center to center of the beams shonw in Fig. 3 was 5 ft. 9¼ in. The slab thickness was 4 in. The width of the beams was 7 in. and their depth was 18 in. Although the load was distributed approximately uniformly over the slab, the gage lines were at the intersection of two aisles and there was no load over them.

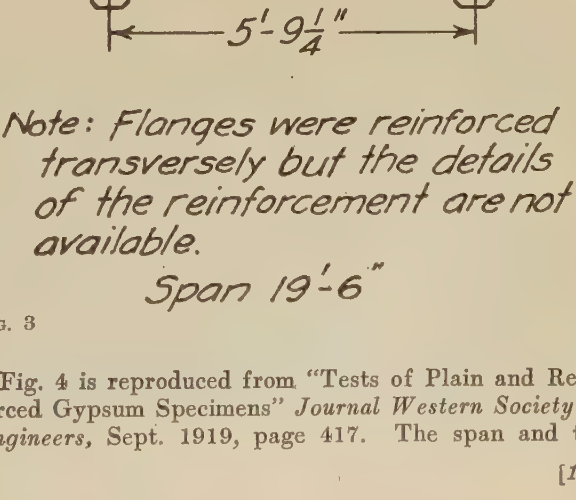

Unit deformation
.0002
.0001
0
327
325
323
321
319
317
315
5'-9 1/4"
Note: Flanges were reinforced transversely but the details of the reinforcement are not available.
Span 19'-6"

Fig. 3

Fig. 4 is reproduced from "Tests of Plain and Reinforced Gypsum Specimens" *Journal Western Society of Engineers,* Sept. 1919, page 417. The span and the width of the reinforced gypsum specimen, etc., are given in the drawing. As with Figs. 1 and 2 in the other cases the loaded areas were confined to the width of the webs.

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[1] Published by permission of the Director of the Bureau of Standards of the U. S. Department of Commerce.

The effective width is taken for this discussion as the width in which the total compressive stress would have been resisted if there had been no reduction of intensity of stress toward the edges of the flanges. It is assumed that the total stress was proportional to the average observed unit deformation multiplied by the cross-sectional area of the flange. It will be seen by reference to Fig. 2 that the effective width was considerably greater for the portion of the slab included between ribs than for the outstanding flanges shown either in that figure or in Fig. 1. There were eccentricities in the distribution of compressive stresses over the width of the flange of the beam of the Turner-Carter Building which prevent direct use of the data of Fig. 3 for showing the effective width. If, however, the average of the deformations in gage lines 315 and 327 be taken as the average deformation over the rib the effective width is found to be 95% of the distance between ribs. In the gypsum beam the deformations were so nearly equal at all points in the width of the slab that the effective width in Fig. 4 may be taken to extend out to the edges of the flanges on both sides.

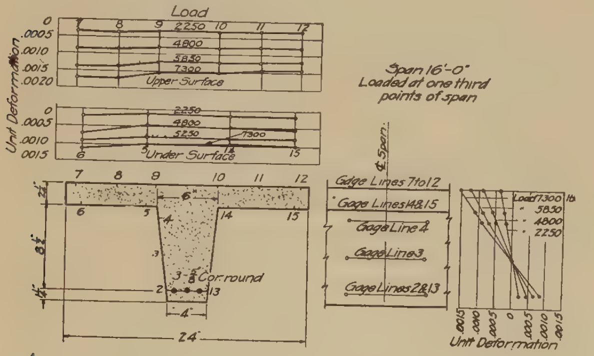

FIG. 4

The results of these tests have a direct bearing on current practice in the design of T-beams of reinforced concrete. The accompanying table gives the requirements of several design standards and for comparison the corresponding dimensions of the beam tested.

The term "isolated beams" in this table may be taken to designate the sort of structure described in the tentative report of the Joint Committee as "isolated beams in which the T-form is used only for the purpose of providing an additional compression area." The beam shown in Fig. 1 and the outstanding flanges of that in Fig. 2 may be assumed to represent this case. The portion of the flange between the ribs of Fig. 2 may be assumed to represent the conditions found in the more usual cases.

There was cross reinforcement in the slab shown in Fig. 3 which served the same purpose as the cross reinforcement in Figs. 1 and 2. In the beam shown in Fig. 4 there was no cross reinforcement and yet the compressive stress was carried out into the flange with little diminution. That this cross reinforcement performs a function is shown, however, by tests made in the same series as that from which Fig. 1 is taken. When the cross reinforcement in that series was placed in the bottom of the flange the flange deflected downward under load although the load was applied only over the stem of the beam; when it was placed in the top of the flange the flange deflected upward; when it was placed in both the top and bottom as in Fig. 2 or in the middle of the depth of the flange there was almost no deflection either up or down. In most cases where T-beams are employed other considerations in the design will require that there be cross reinforcement in the top of the slab, but where they do not it is important that it be furnished for the purpose of giving integrity to the T-beam construction, otherwise cracks due to slab moment along the stem may destroy the effectiveness of the slab for resisting compression developed in the beam.

Five of the standards listed in Table I require that the slab shall have cross reinforcement as a condition

TABLE 1—BUILDING CODE REQUIREMENTS FOR T-BEAMS AND DIMENSIONS FOR TEST BEAMS

	Joint Com. 1916		Joint Com. Tentative 1921		Detroit, 1919												
Ratio of:	Interior	Isolated	Interior	Isolated			Chicago, 1912	New York, 1915	Boston, 1919	Cincinnati, 1917†	Cleveland, 1919	Pittsburgh, 1913	San Fran. 1920-21	St. Louis, 1917-18	Fig. 1	Fig. 2	Fig. 3	Fig. 4
Maximum allowable* width of flange to span of beam	0.25	....	0.25	....	§0.33	....	0.33	$.33+\frac{b}{l}$	.25	....	.25	....	....	....	0.5	0.4	0.294	0.125
Maximum allowable* width of overhanging flange on either side to web thickness	....	3.0	....	4.0	....	¶3.0	....	....	....	....	....	3.0	....	....	3.25	2.5	4.44	2.0
Maximum allowable* width of flange on either side to flange thickness	6.0	....	8.0	....	§6.0	....	....	6.0	6.0	6.0	6.0	4.0	5.0	3.0	8.13	8.34	7.78	4.44
Maximum allowable* width of flange on either side to clear distance to adjoining web	....	....	0.5	....	§0.5	....	0.375	....	....	....	....	0.5‡	....	0.5	.....	.....	.....	.....
Minimum allowable* flange thickness to web thickness	....	....	....	0.5	....	....	....	....	....	....	....	....	....	....	0.4	0.3	.572	0.45
Minimum allowable* flange thickness to depth of beam	....	0.33	....	....	....	¶0.25	....	....	....	....	....	....	....	....	0.266	0.2	0.222	0.188

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*For the last four columns the dimensions given are those used in the test beams, rather than "allowable" dimensions. Therefore, the values given in those columns are not a measure of the test results. Some idea of the bearing of the test results on requirements in this respect may be obtained by inspection of the figures.

†The Cincinnati code provides that "when the floor reinforcement is perpendicular to the beam, the entire floor can be used in compression." The regulations quoted here apply to the case where the slab reinforcement is not "perpendicular to the beam."

‡Based on distance, center to center, of beams rather than clear distance.

§Interior.

¶Isolated.

under which the slab may be considered to be effective as the flange of a T-beam in resisting the compressive stresses. One specifically states that the requirements given apply when there is no reinforcement in the slab perpendicular to the beam, but that as a condition of using greater effective widths there shall be such slab reinforcement. Five of the standards require that the slab and beam shall be poured monolithically and four others include the general provision that there shall be adequate bond beteween the slab and the beam. It seems that some such provisions as those noted in this paragraph should be included in a standard for design, though in laboratory beams where there was no tendency for shrinkage stresses to cause cracks at the edge of the stem the flange has proven to be effective in resisting compression even when there was no cross reinforcement in the flange.

With the possible exception noted in the preceding paragraph the indications are that in this country standards for the design of T-beams have generally been conservatively drawn, at least so far as they have to do with participation of the flanges in the compressive stresses developed, and this discussion does not touch upon other features, such as compression in the web in continuous beams of T shape.

Gunite Stadium Seats Tested

The test of a section representing a stadium seat built up of gunite, recently conducted at the concrete products plant of the Cement Gun Construction Co., at Harvey, Ill., was made to bear out the company's opinion that in building stadium seats and similar structures engineers are using much heavier structures than are necessary, and to prove that instead of using ordinary concrete and making structures 4 in. to 6 in. thick, better results can be obtained if a higher grade concrete, like gunite, is used, enabling the designers to cut down the thickness to 2 in. or 3 in.

The diagram in Fig. 2 shows the detailed design of a 16 ft. section, made in February, 1922. With the intention of loading the test section to destruction, a uniform load of 150 lbs. per sq. ft. was applied in the presence of a committee which had in charge the building of a certain college stadium. Then the members of the committee sat on top of the load. A week later the load was increased to 250 lbs. per sq. ft. Then all the bricks which could be piled on without their falling off were thrown on top, getting the load up to 291 lbs. per sq. ft. When no more bricks would stay on, four men climbed on top of the pile and endeavored to break the specimen by teetering. They finally gave up trying to break it, and the test was not carried to destruction.

The final load, with the four men on top, as shown in Fig. 3, was 301 lbs. per sq. ft. Under this load the deflection at the center was a little over 1 in. A number of fine cracks developed under load. When the entire load was taken off the deflection came back to ¾ in. There was no evidence anywhere of any crushing of the gunite. Evidently, the steel had simply been stretched and had not gone beyond its elastic limit.

The Cement-Gun Construction Co., from which the above information was obtained, has been advised that one of our universities recently tried to find out how much human weight could be put on a floor 10 ft. square. It was found that by sandwiching in big and little students, the resulting load amounted to the equivalent of a uniform load of 35 lbs. per sq. ft.

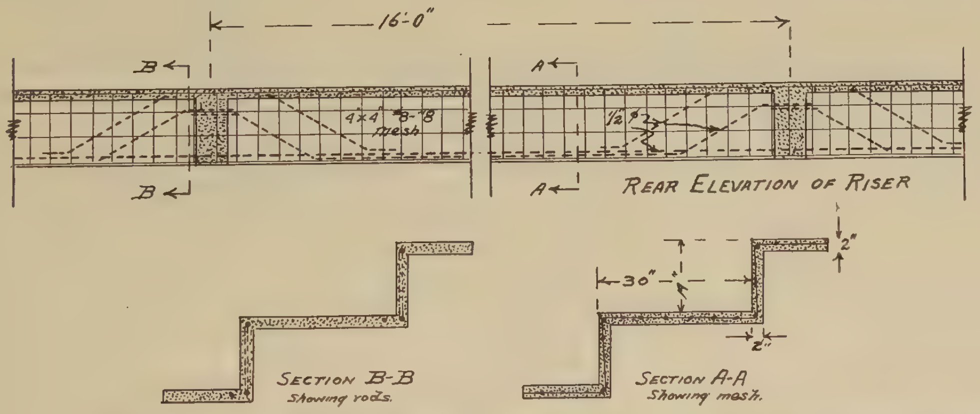

FIG. 1 — DIAGRAM SHOWING THE DETAILED DESIGN OF A 16-FT. SECTION OF GUNITE STADIUM SEATS TESTED

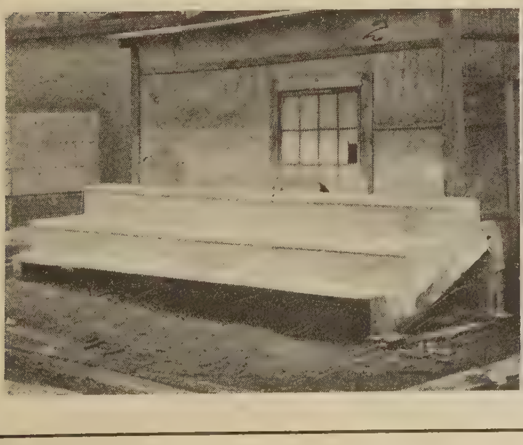

FIG. 2—(LEFT) GUNITE SECTION READY FOR TEST

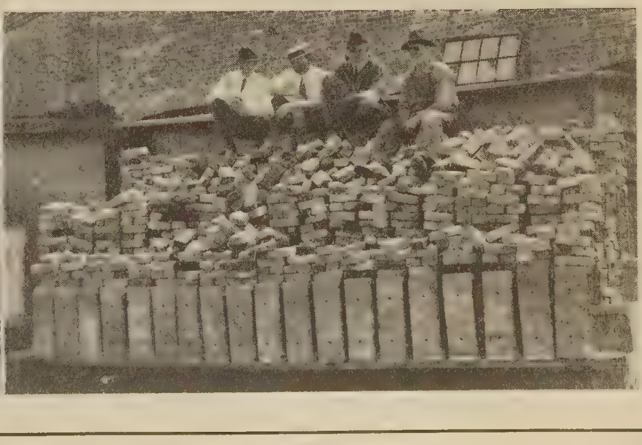

FIG. 3—(RIGHT) UNDER A LOAD OF 301 LBS. PER SQ. FT.

Use of Concrete in Alkaline Soils[1]

BY HENRY S. KLEINSCHMIDT
CONSULTING ENGINEER, SALT LAKE CITY
MEMBER A. S. OF C. AND A. A. E.

Concrete tile has been in use in this state, for drainage purposes in alkaline soils, on an extensive scale since 1916. Prior to that time its use had generally been deemed inadvisable owing to cases of failure or disintegration of concrete in the presence of alkalies. However, in 1907 and even earlier, small installations of concrete tile had been made in alkaline soils in Utah.

When drainage of water-logged alkaline lands began in Utah on a large scale, about 1916, the advisability of using concrete tile became of great importance, because of the added costs where the tile had to be shipped long distances from the point of manufacture. Excellent sand and gravel were usually available close at hand to where the tile was to be used, and the cost of small concrete pipe making plants was nominal.

Two drainage districts, operating under the State Drainage District Law, the Corinne district, embracing about 10,000 acres in Box Elder County, and Sevier County No. 1 of about 4,500 acres, near Richfield, Sevier County, reached the construction stage at about the same time, namely, the fall of 1916.

One of the small installations of concrete tile referred to was near Richfield, consisting of about 500 ft., serving as outlet for an experimental drainage system installed by the Drainage Investigations, U. S. Dept. of Agriculture. The conditions were identical with those to be found over a considerable part of the drainage district, which included the experiment mentioned. This tile, and other tile which had been in place under similar conditions, were examined, and found to be in perfect condition, after practically 10 years' use. Similar investigations were made for the Corinne district, and after all available information as to the behavior of concrete under the conditions to be met on these districts, had been examined, the decision was reached to allow the use of concrete tile in these districts. Both of these districts were advised by the Drainage Investigations, U. S. Department of Agriculture, that the use of concrete tile was an experiment.

In addition to these two districts, concrete tile has been used in Utah on the following drainage projects, all of which embrace lands the major part of which contain considerable quantities of alkalies: Logan Land & Drainage Co., Cache Valley; Sevier County Drainage Districts 4, 5, 6; San Pete County Drainage District No. 1; Millard County Drainage District No. 1, Hinckley; parts of Davis County Drainage District No. 1. The combined area of these, including Corinne and Sevier County No. 1, is about 30,000 acres, and the amount of concrete tile used over 2,000,000 ft. Most of this work has been completed for from two to six years.

On this work the tile has been uncovered in hundreds of places for the purpose of making connections to drains, repairs, cleaning, or for examination. Not one case of breakage of concrete tile by crushing has been reported to the writer, who, by the way, was engineer for all the above, excepting Corinne, Millard County No. 1 and Davis County No. 1, being associated, however, on the latter. Only one case of concrete tile affected by alkali has been reported. This was on Sevier County No. 1, where, in a clogged drain, which had never operated, four adjacent pieces of 5 in. tile were found, about one year after installation, each with about 6 in. of one end affected. This matter was thoroughly investigated, and it was determined that these tile were part of a lot of poorly made tile, made at a time when inexperienced men were operating the tile plant. The writer is certain that the affected part was the upper end, which had been improperly tamped during making, resulting in a very loose open tile wall. Tile removed on the Corinne District for testing, after being in place about one year, in every case carried a breaking load of from 25% to 50% greater than the breaking load of test tile tested 30 days after manufacture.

Tile used in the above work was machine made, of good aggregates, and standard brands of portland cement, made in Utah. The mix was 1:3, consistency such that metal tile molds could be taken off immediately after manufacture; cured for 24 to 48 hours in steam or fog chamber, then piled in the open and sprinkled for from one to three weeks before being distributed for use.

The writer is of the firm opinion, based on its performance in the work under his observation, that concrete tile for use under conditions similar to those in the projects named above, when made of good clean aggregates, proportioned not leaner than 1:3, thoroughly mixed, well tamped, and properly cured, is an entirely satisfactory product, and will be unaffected by the alkalies in the soil, and in the water flowing through the tile.

The writer has seen concrete tile and clay tile lying side by side through the winter on a ground surface white with alkali, so that when examined in the spring the tile were practically full of alkali deposited by evaporation. In such cases a considerable percentage of the clay tile was invariably found to have badly spalled off or to have disintegrated so as to collapse. On the other hand, I have never found a concrete tile after such exposure that showed any spalling or any other effect of alkali or weather. This is not to be taken as a reflection on clay tile, which, when properly made and placed underground, renders entirely satisfactory service. Concrete tile has the advantage in that it may be formed true in shape, with clean square ends, so that in general a better junction may be made with concrete than with clay tile. This is of distinct advantage in fine sand of other unstable soils where a close, well fitting junction is necessary. Concrete tile may also be very readily trimmed or cut for making angles, and for joining one drain to another.

Much may be said as to why concrete fails under some conditions, but this would lead into technical phases of the subject. Suffice it to say that any material used in any kind of construction, if not properly made, handled, or if abused, will fail.

Analyses of alkalies on some of the projects referred to follow:

Sevier County No. 1, Experimental Tract—Total salts, 0.4% to 0.6%; calcium sulfate (gypsum), 6.68%; magnesium sulfate (Epsom salt), 3.10%; sodium sulfate (Glauber's salt), 18.29%; sodium chloride, 42.0%.

Corinne District—Total salts, 1.0% and over; calcium sulfate, up to 9.5%; sodium sulfate, up to 9.1%; sodium chloride, 70% to 85%; magnesium chloride, up to 5.5%.

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[1] Courtesy American Concrete Pipe Association, which has published, Mr. Kleinschmidts' statement in leaflet form.

Logan Land & Drainage Co.—Total salts, 1.27% to 6.39%; calcium sulfate, 30.82% to 44.65%; magnesium sulfate, 7.09% to 8.81%; sodium sulfate, 11.18% to 30.82%; sodium carbonate, 11.18% to 35.75%; sodium chloride, 9.57% to 13.15%.

The following replies were received to inquiries concerning concrete tile:

Corinne, Utah, June 27, 1922.

H. S. Kleinschmidt,
Margetts-Kleinschmidt,
Salt Lake City, Utah:

Dear Mr. Kleinschmidt—With reference to the use of concrete pipe in mineral soil, beg to say that we have tiled about 10,000 acres of mineral land with concrete tile, and the same has been in the ground from five to six years, showing no deterioration up to the present. The character of the mineral salts in our soil is largely chloride of sodium, a mere trace of the other salts being present. The pipe used was manufactured on the ground from aggregate of high class, and cement made by Ogden Portland Cement Co. The mix was worked as wet as possible to handle; was cured 48 hours in steam room; sprinkled for three weeks following.

Sincerely,

(Signed) C. G. Adney,
Pres. Corinne Drainage District.

Logan Land and Drainage Co.
Logan, Utah, June 24, 1922.

Margetts & Kleinschmidt,
Salt Lake City, Utah:

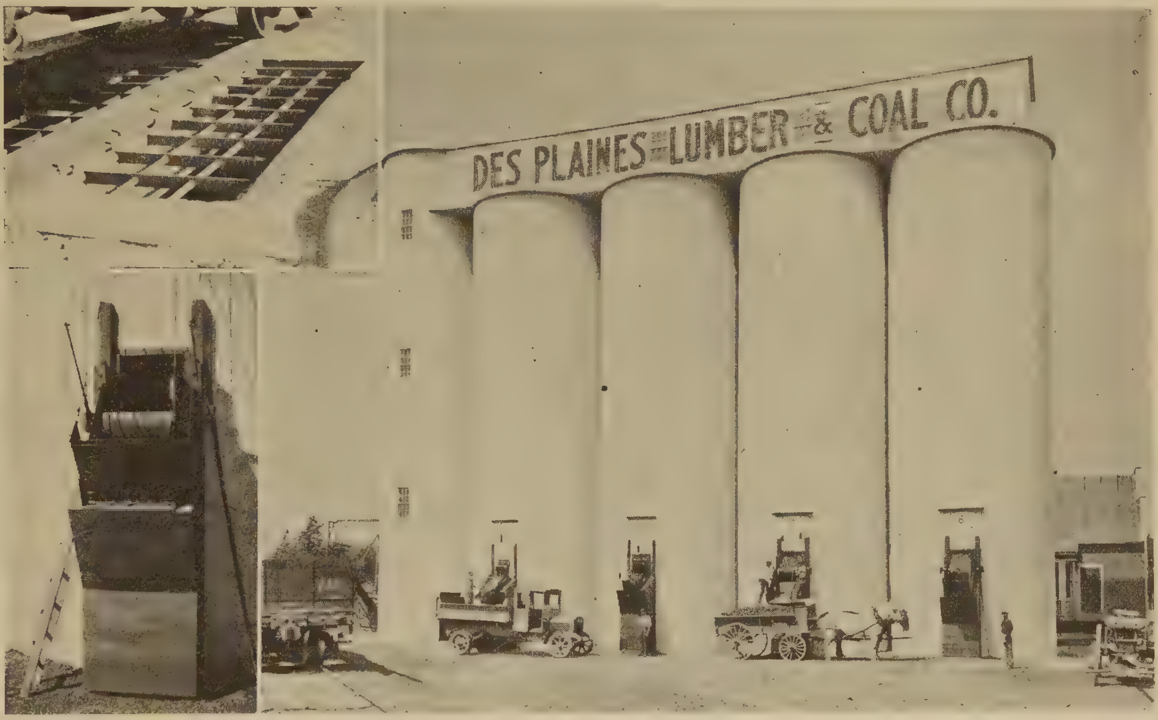
Gentlemen—I have your letter of the 22nd asking for information on cement tile.

This company has had installed in its drainage project cement tile for six years. While we have never had a physical or chemical analysis made of this tile, yet we have found nothing whatever to indicate any deterioration having set in because of alkali. The tile appears to be in better shape than when put into the ground.

Sincerely yours,

(Signed) A. F. Cardon,
Manager.

AFC-A



The Coal Pockets of Des Plaines Lumber & Coal Co.—Used Also for Storage of Sand, Gravel and Stone—Hopper Top, Where Freight Cars Feed to Elevator Shown (Upper Left)—Loading Chute (Lower Left)

Concrete Material Pockets for the Des Plaines Lumber & Coal Co.

By A. J. R. Curtis

Due to the high cost of labor and the great difficulty of securing it at any price, many retail coal dealers have built modern concrete coal pockets to reduce the cost of handling coal.

The Des Plaines Lumber & Coal Co., Des Plaines, Ill., recently put up one of the finest silo type pocket installations built to date, using reinforced concrete construction throughout and equipping it with modern electric-driven elevating machinery of latest design. While all four of the tanks are suitable for the handling of coal, two were especially reinforced for use during the building season as containers for sand, pebbles and stone, being used during the remainder of the year for coal. Few pockets of this type have been used for aggregate handling heretofore, and results were naturally awaited with interest. A carload of any kind of coal or of aggregates can be unloaded from the car and elevated to the tanks in an hour and a quarter, and can be run out by gravity into wagon or truck at the rate of 5 tons per minute from each of the 8 chutes. The cost for power and labor, from car to wagon, is about 6 cents per ton, as against 50 cents to 75 cents per ton ordinarily assumed as the expense of shoveling from car to pile and from pile to wagon.

The Des Plaines coal pockets are of monolithic construction, built by the W. H. Warford Construction Co., of Aurora. There are four detached circular tanks 18 ft. in inside diameter, 60 ft. high (above the floor, which is at the grade line), a circular elevator house 14 ft. in inside diameter, 70 ft. high, and a rectangular concrete head house, containing upper portions of the handling machinery, with concrete slab roof. There are also concrete track hopper, tunnel and driveway slab. The tanks and all of the circular work was done with Polk system steel silo forms.

Tank and head house wall are 6 in. thick. Coal tank walls are reinforced vertically with 3/8-in. round rods, 18 in. on centers, and horizontally with ½-in. and 3/8-in. rods, beginning at the bottom with 1/2-in. rods spaced 8 in. apart, spacing out gradually to 3/8-in. rods 8 in. apart at the top. Reinforcing in the walls of the interchangeable coal and aggregate walls is considerably heavier. The four tanks are divided by vertical concrete partitions into 2 bins each, giving a total of 8 bins, each with a capacity of 190 tons of bituminous or 210 tons of anthracite coal, giving the entire plant a capacity of about 1,520 tons of bituminous coal, or 1,680 tons of anthracite coal. Each bin has its own spout or chute, fitted with counter-balanced gate, interchangeable screen and dust box.

The track hopper is 10 ft. by 12 ft. at the top, and is 9 ft. deep. It is fitted with a heavy bar screen, 6 in. mesh, to retain lumps of greater size. The elevating and conveying machinery is of the endless chain and bucket type, furnished by the Gifford-Wood Co., Chicago. The steel conveyor buckets are 18 in. by 24 in. at the brim, plenty large for handling coal of any size that can be admitted through the screen at the track hopper. A 5 h. p. electric motor drives the buckets at a speed sufficient to elevate 50 tons in 75 minutes. In the circular elevator house there is a steel ladder and also a very convenient counterbalanced man-lift, a very useful adjunct in looking after machinery. Only one man is required to operate the entire mechanism, including "pinching" along of cars where required, in unloading. Additional labor is required, of course, if other than hopper bottom coal cars are supplied.

What might be regarded as the supreme test as the efficiency of these tanks came early during the present season, when they successfully handled not only the larger sizes of soft coal, but also the large size Pocohontas coal, which is a very soft semi-anthracite, quite subject to breakage with consequent usual high percentage of loss to the retailer from this cause. Breakage is prevented in these bins by carrying the coal from the elevator point of discharge at the top of tanks to the bottom of the bins or surface of the coal, by means of spirals of substantial metal construction. These spirals have operated very satisfactorily and constitute a decided advantage over former methods of breaking the drop in deep bins. Fine plaster, sand and large stone are being successfully handled in adjoining bins, and the pockets have proven of great value during the entire present season in quickly loading materials for the concrete road and street work in the vicinity, of which there has been a great deal.

When interviewed recently regarding his material pockets, Mr. B. L. Franzen, Jr., president of the Des Plaines Lumber & Coal Co., said:

"After looking over the field of coal elevators, we decided upon the solid reinforced concrete type as best fitted to our needs and requirements, beside giving us a fireproof structure, practically free from upkeep or depreciation, and giving us the strongest possible construction. With concrete tanks, elevator casing, track hopper and head house, we feel that we have built for posterity.

"For expert advice, efficient service and excellent workmanship, we gladly recommend the W. H. Warford Construction Co. of Aurora, Ill., the contractor. The machinery was installed by us under the direction of a competent millwright, by day labor. Everything is very simple and can be operated by ordinary labor. There are no clutches, belts, levers or other cumbersome equipment to handle.

"With this modern equipment we expect to increase our business at least 25%, as it will enable us to make deliveries to surrounding towns and to give better service to our customers everywhere, doubling the capacity of our present delivery system.

"Contractors wishing sand or gravel may send their trucks to the chutes and in a minute or two have them loaded and on their way again. Customers hauling their own coal have the same advantage."

The Fire Loss

A little more debris on the nation's ash heap this year!

Property valued at $230,000,000, which was destroyed by fire up to the end of July.

This sum would have provided homes for 46,000 families at $5,000 each.

Instead, only the ruins of many another home.

As each year rolls up a loss by fire comparably stupendous, fire prevention is becoming a little more earnest and a little more serious proposition.

Faced by the stark fact that the fire loss last year was six times as great as that of forty years ago, and totaled one-half billion dollars, Fire Prevention Week, October 2-9 this year, by proclamation of the President, was seized with more enthusiasm than has been evident in the past as an opportunity to effect coordination in the movement to reduce fire losses. Local commercial bodies throughout the country arranged programs for the week culminating on Fire Prevention Day, October 9.

Henry W. Horst Co., contractors, Rock Island, Ill., apply modern manfacturing methods to contracting, says the *Concrete Highway Magazine*. Among other things, the job superintendent's organization is divided into six departments, each with an executive officer, who is usually a permanent employee, as follows: 1—Field accountant, 2—Civil engineer, 3—Master mechanic, 4—Concrete foreman, 5—Plant foreman, 6—Grade foreman.

The field accountant has charge of all office records, cost accounts, payrolls and material records. The civil engineer is a staff officer, not directly in charge of any one department, but acting in an advisory capacity to all. To him are referred questions of layout, equipment and technical problems which arise during the progress of the work.

The master mechanic is in charge of the maintenance of equipment. His crew of mechanics keeps the trucks and all mechanical equipment in repair. On all equipment except trucks the operator makes his own repairs, assisted by the repair crew.

The plant foreman is responsible for the storage of material, the mixing of the concrete and the general upkeep of the plant. The concrete foreman is in charge of placing and finishing the concrete, and the grade foreman prepares the sub-grade.

Tests of Concrete in Sea Water[1]

By L. C. Wason
President Aberthaw Construction Co.
Boston, Mass.

In the summer of 1901 the writer was frequently at the Charlestown Navy Yard and observed the building of Pier No. 1 of concrete. This concrete was mixed so dry that no water showed on the surface when tamped in place. In a few years this pier showed serious defects.

The writer and his associates discussed with various engineers the cause of this early failure. Many reasons were advanced, but no conclusion was reached. We broadened the discussion through the technical press, without obtaining a satifactory answer. Then we decided to investigate the cause. After extended publicity and correspondence, a series of test specimens, numbering 24, all 16 in. square in cross section by 16 ft. long, were made of various qualities of concrete. Three different proportions of cement, sand and broken stone and three different amounts of water were used. These were made in the first half of January, 1919, and were immersed in the sea at the Charlestown Navy Yard the last week of February.

They were suspended so that the top of each specimen was about grade 12½. As the average height of tide is 8 ft. 9 in., there was something over 3 ft. of specimen which would seldom be wet and presumably never immersed, while about 3½ ft. projected below mean low water, or grade zero, and therefore would never be uncovered.

The details of making, and progress reports of their condition have been published in two pamphlets, entitled "Aberthaw Tests on Concrete in Sea Water," issued in 1914 and 1920, a number of articles in the technical press,[2] and most fully described by Captain R. E. Bakenhus, civil engineer, U. S. N., in paper No. 1393, in the *Transactions of the American Society of Engineers*, Volume LXXXI, December, 1917. Reference is made to these sources for full details. Only such extracts from that data will be made as are necessary to make this paper intelligible.

After 13¼ years of immersion and study, the writer thinks it is possible to make some tentative deductions as to the causes of failure, and how to design future structures so as to be as nearly proof against disintegration by sea water as is possible.

The conditions in Boston Harbor are probably as severe as in any harbor of the United States. There is considerable tide where the specimens hang under Pier No. 9. They are attacked by waves, stirred up by the wind or the wash of ships; there is chance for a certain amount of abrasion from floating objects; there is freezing from severe northern winters; there is attack from impurities, chemical or otherwise, present in sea water.

In April, 1914, the Navy put into commission fuel oil pipes on Pier 9, adjoining these specimens. Enough oil is spilled on the sea to have heavily coated the specimens from near their tops to low tide. In the opinion of the writer this retards action by the sea, and therefore will extend for a longer period the full result of the sea water test, but it has not entirely destroyed the value of this test.

On May 22, 1922, at low tide, the writer made an examination of the specimens. No appreciable change could be observed from the report of 1920, made by the Aberthaw Co. and published in the pamphlet of that year, referred to above. The order of deterioration is the same as that given by Captain Bakenhus' report of 1917.

Of the 24 original specimens, numbers 19 and 21 have been lost; of the remaining 22, five are in poor condition and may be considered to have failed so far as resistance to immersion in sea water goes. These are Nos. 7, 11, 13, 22, and 23. All were mixed with 1 part cement, 3 sand, and 6 stone. Captain Bakenhus makes nine classes, or degrees, of failure. He puts No. 7 in the worst class, Nos. 22 and 23 next to the worst, that is, Class 8, Nos. 11 and 13 are in Class 6, fair condition. No. 7 was mixed dry—the rest wet.

Four others show some deterioration, Nos. 1, 4, 8, and 9. Nos. 1 and 4 are rich proportions, but mixed dry. Nos. 8 and 9 are plastic and wet mixtures, but of lean proportion.

The rest, Nos. 2, 3, 5, 6, 10, 12, 14, 15, 16, 17, 18, 20 and 24, are in pretty good condition.

On May 24, 1922, specimens Nos. 7, 11, 22, and 23 were removed for testing purposes.

No. 7 was made of three average, normal portland cements, Vulcanite, Alpha, and Giant, in equal parts, thoroughly mixed together and repacked in bags for use in mixing the concrete.

No. 11 was made of Blanc (white portland cement), very wet.

No. 22 was made of 9/10 part of the same cement as No. 7 and 1/10 part of hydrated lime, very wet.

No. 23 was made of cement like No. 7, plus Sylvester solution of soap and alum, very wet.

When the specimens came out of the water there was about ¼ in. of gummy, sticky adhesion of fuel oil and dirt at the tops, which towards the low water mark became thinner, with harder surface, somewhat glossy.

Below low water there were no signs of oil at all, but the specimens were coated with mussel shells, alive, which showed that the water impurities were chiefly those floating on the surface and not sufficient to kill marine life.

Some of the specimens had in the handling of previous years become cracked as they were taken out of the water, some pieces falling off at the cracks showing a very slight brownish discoloration, which indicated that the oil did not penetrate very deep, or in any volume into these cracks.

Where a fresh fracture of concrete occurred there was no evidence of any penetration of oil below the surface of even the poorest specimens. Discoloration was not more than 1/32 in. deep.

In all these specimens the portions most damaged, namely, near mid-tide, showed rather disintegrated and soft concrete.

These specimens were taken to the writer's shop. There they were cut to approximately square faces, making the specimens more than twice as long as cross section. The steel reinforcement was cut off by oxyacetylene torch burned below the surface wherever it appeared. The workmen found a noticeable difference in the difficulty of cutting with hammer and chisel Nos. 11 and 23.

Then they were taken to a stone working plant and faced on a revolving polishing bed to a flat surface resembling terrazzo. By the courtesy of Professor H. W. Hayward, they were crushed in the million-pound testing machine at the Massachusetts Institute of Technology, on June 7, 1922.

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[1] From a paper read at the annual convention of the American Society of Civil Engineers at Portsmouth, N. H., June 21, 1922.

[2] See Concrete, June, 1922, page 230.

The top end of No. 7 was so short and so badly cracked that it was impossible to get a test specimen out of this larger than approximately 8 in. square by 15½ in. long. All the others were full size specimens.

A piece of blotting paper was put under the top bearing of the testing machine on the first specimen, and under both bearings of the remaining specimens. The impression made upon these sheets after tests were completed give an indication of the net bearing area, and the character of the bearing. The edges of the specimens were rough and ragged. On some the corners were broken so that it was difficult to obtain the bearing area by direct measurement of the specimen itself.

The writer laid these sheets of blotting paper out on a drawing board and as accurately as could be done by the eye determined the average bearing area of each end, as shown in Table 1. This is an approximate area only, and the writer is convinced that if he has erred, it is in making the area too large, rather than too small, so that the crushing strength per square inch would be, if anything, smaller than the actual.

The testing was simply carried to the point of failure of the specimen. Cracks appeared in normal, ordinary way longitudinally, and formed roughly two prisms of hour glass shape.

Wherever reinforcing steel was exposed after the tests it appeared bright. The most porous specimen of all, No. 7, was so broken afterward that reinforcing bar was entirely removed. With the exception of three spots about one-quarter inch in diameter which showed rust, the bar was entirely bright. This was from the lower end, which had been permanently immersed for 13¼ years.

A test piece was taken from the top of the top end specimens, and two test pieces, one from the lower corner of the bottom specimen and one from near the center were taken for chemical analysis. Herbert L. Sherman, a cement chemist, cooperated with the writer in testing chemical and physical analyses of the cement in the making of the specimens, and we wish to acknowledge his hearty cooperation in testing these specimens to see what chemical changes, if any, have taken place.

After a careful and complete analysis of three samples each from specimens Nos. 7 and 23, and a thorough study of the results, Mr. Sherman reports that it is impossible to draw any conclusions and that the result of his chemical analysis is meaningless. Therefore, his figures are not reproduced.

When a workman was breaking specimen No. 11, bottom end, to get a sample of interior, he exclaimed that the concrete was wet. It certainly appeared so, although it had been out of water 14 days.

The result of the crushing test is given in Table 2. The original cross section is copied from the earlier report, and is not a scaling of the specimens at the present time. The length of specimens and column of actual area is from measurements taken at the time of test as described above.

It will be noted that the normal mixture of concrete shows as good result as could be expected of any concrete of this mixture and age. It will be noted also that the bottom end of each of the four tests is stronger than the top ends.

Omitting No. 7, where a small sample only could be tested and therefore may not be directly comparable with its own bottom, the other three show a ratio of strength of top to bottom of about 92%, which indicates that there is some common law as to the condition of the concrete when permanently wet as compared with dry.

In 1912 the writer built a fish pier in Portland Harbor. This consists of a wharf supported by concrete piers about 4 ft. square with a heavy floor above forming the wharf platform, on which a fish house was built. Most of these piers were built inside of a cofferdam, were therefore cast dry, and were allowed to set for over a month before being subjected to the tidal action of the sea.

Two rows nearest the shore being out of water, except during high tide and never having emersion of more than about 3 ft., were cast between tides. An examination of these was made on May 25, 1922, when ten years old. All the piers cast within the cofferdam appeared in first class condition. Those cast between tides showed some signs of deterioration below high tide line.

In 1902 a series of specimens was made to test the protection of steel from corrosion by concrete. Concrete was mixed 1:3:6 with the expectation that it would be porous. The blocks were 4 in. square and 12 in. long, and had a ½ in. square twisted steel bar 16 in. long running through the center and projecting at both ends.

One series of these was immersed in sea water under the auspices of the War Department at Fort Warren and after three years' testing the remainder of the specimens were lost.

The second series was given to the chief engineer of the Metropolitan Sewerage Commission, and were immersed in a trunk sewer. After seven years the remainder of the specimens were lost.

The third set was buried in the ground, always damp, sometimes saturated with water, underneath where a waterspout from the roof of a building dripped. A specimen from this group, after being 20 years in the ground, was removed and split open. In every specimen of all three series, where the cement was in hard contact with the steel, it came out bright. Where there were voids there was rust. When the bars were originally embedded, they were coated with hard rust but no scales. This would indicate that cement will protect steel from corrosion in unfavorable conditions.

Conclusion

While it is not time to draw final conclusions from these series of tests, and while the series is not sufficiently comprehensive to prove a general rule for all cases of immersion of concrete in sea water, we think that some conclusions are now justified, and ought to be helpful to those designing marine structures in the future.

First of all, it appears that the mechanical action of the elements are a much more vital point of consideration than chemical action. Those specimens which were most dense show the least sign of wear today. Those specimens which were built porous, with the expectation that they would soon disintegrate, have done so.

Chemical action must be considered. The specimens made of cement low in alumina, both lean and rich mixtures, are in good condition and lead the series. Those which had foreign ingredients, numbers 22 and 23, of hydrated lime and Sylvester solution, show serious weakness, while on the other hand, one specimen containing 5% of clay as filler to make the concrete dense, is still in quite good condition.

The question of the amount of water used in mixing must be considered.

The condition of the specimens tested by Dan Patch, one of the writer's associates, indicates that those containing 9% to 10% of water are in better physical condition than the very dry or very wet specimens.

In placing concrete in forms, if the workmanship is good, excess of cement and mortar is brought to the surface and produces a skin which resists sea water action very well until abrasion has removed it. The concrete below is not so durable in resisting wear as this skin.

The specimens which are made of the poorer materials which earliest fail, due to tidal action, in their lower portions which are permanently immersed, have proved durable.

An explanation of the reason for the top end showing less strength than the bottom end, may be partly due to the matter of suspension. In order to handle the specimens readily, ⅝ in. square steel bars were run the full length through two diagonal corners about 2 in. from the surface. A hole was cored in the center of the specimen, and into this was grouted a hook with a shank about 3 ft. long, by which the specimen was suspended. The dead weight of the specimen is first carried by the reinforcing bars, and in the upper 3 ft. the load is transferred through the mass of the concrete itself to the hook. This produces some tension in the top member equal to about 100 lbs. per linear inch of specimen in the upper 3 ft. This condition may have produced porosity, or cracks invisible to the eye, through which the specimen weathered. The top end was subjected to annual variations of temperature of probably 100°, and at times to changes of many degrees within a few hours —at times to a film of ice upon the surface, and to a slight degree of abrasion from floating objects in the water.

It seems safe to conclude that if rich concrete is made from a good quality of cement, normal composition, or low in alumina, and material is thoroughly mixed, using 9% to 10% of water and placed in the dry with careful workmanship, spading to assume a dense surface, that we can be assured of durability in sea water unless there is a considerable amount of abrasion, in which case it will be a wise precaution to face the concrete within the limits of tidal rise and fall with a protective coating. Below low tide, and above high tide, concrete as above described is a practical, satisfactory and proper building material.

TABLE 2—CRUSHING LOAD ON SEA WATER TEST SPECIMENS

No. of Piece		Original Cross Section, inches	Area, sq. ft.	Length Test Spec., inches	Actual Section, inches	Total Load, lbs.	Load, sq. in., Actual Section	Ratio Strength Top to Bottom
7	Top	15⅞x16 3/16	1.82	15½	57.3	157,300	2,750	.82
7	Bottom	15⅞x16 3/16	1.82	35½	231	778,800	3,375	
11	Top	16 x16¾	1.86	36	236	750,200	3,180	.93
11	Bottom	16 x16¾	1.86	37	240	823,900	3,435	
22	Top	15⅞x16⅜	1.80	30¾	207.5	463,100	2,235	.92
22	Bottom	15⅞x16⅜	1.80	36	212.5	562,100	2,645	
23	Top	16 3/16x16¼	1.82	32½	226.5	391,600	1,730	.91
23	Bottom	16 3/16x16¼	1.82	33¾	222.5	424,600	1,907	

For easy comparison with laboratory specimens, below is summarized tests on 1:3:6 concrete mixed dry, plastic and wet, on four brands of cement, cured in air for 1.6 to 1.75 years. Specimens are 12 in. cubes. Extract taken from annual report of State Engineers of New York for fiscal year ending September 30, 1897. State Printing Office, Albany, 1898. Fifty-two specimens crushed at Watertown Arsenal. Dry specimens 9% stronger than plastic or wet.

Highest crushing strength per sq. in.	2,887 lbs.
Lowest crushing strength per sq. in.	1,716 lbs.
Average of 52, crushing strength per sq. in.	2,095 lbs.

TABLE 1—ACTUAL BEARING AREA OF TEST SPECIMEN IN TESTING MACHINE AT MASSACHUSETTS INSTITUTE OF TECHNOLOGY

7	Top	Top bearing	51.2 sq. in.
		Bottom bearing	62.8 sq. in.
		Average	57.3 sq. in.
7	Bottom	Top bearing	232 sq. in.
		Bottom bearing	230 sq. .ni
		Average	231 sq. in.
11	Top	Top bearing	236 sq. in.
11	Bottom	Top bearing	240 sq. in.
22	Top	Top had a poor bearing	200 sq. in.
		Bottom bearing	215 sq. in.
		Average	207.5 sq. in.
22	Bottom	Top bearing	217 sq. in.
		Bottom bearing	208 sq. in.
		Average	212.5 sq. in.
23	Top	Top bearing fair	213 sq. in.
		Bottom bearing	238 sq. in.
		Average	226.5 sq. in.
23	Bottom	Top bearing	221 sq. in.
		Bottom Bearing	224 sq. in.
		Average	222.5 sq. in.

Concrete Curb Safeguards Texas Highway

To obtain far greater safety for motorists using the highway that passes under the Southern Pacific R. R. tracks, near Weimar, Texas., three curbs have been built at the dangerous curves. The middle curb, 8 in. high, divides the roadway into two lanes, each 10 ft. wide. The concrete abutments of the bridge structure cut off the view of approaching vehicles, and made the curve a dangerous one. Now all motorists can read the sign, "Keep to the Right." It greets them from an 8-in. concrete post at the end of the middle curb. The length of the underpass that has this curbing is 200 ft., and there is also a 200-ft. length of approach that is paved with concrete. B. H. Faber, of Colorado County, Texas, was the engineer.

Four main causes of the disintegration of cement tile in peat, according to F. J. Alway, in the *Journal of the American Peat Society*, are humic acids, which remove the lime from the cement; iron sulfide, which on exposure to oxygen and moisture, oxidizes to iron sulfate and sulfuric acid; hydrogen sulfide which reacts with the lime of the cement to form calcium sulfide; and alkali water when it contains sodium sulfate, magnesium sulfate and magnesium chloride which react with lime to form either soluble compounds or those having larger molecular volumes.

School Studies of Concrete for a Month

By H. D. Kemperton

In the Cicero, Ill., Public Schools pupils are centering all their school work on one special subject at a time. In the fifth grade, for instance, pupils devote an entire month to the study of concrete and building stone. They not only discuss it once a day; every study is about some phase of these materials. Textbooks such as are used in ordinary schools are unknown. These children find out all they can about concrete from any possible source.

Their drawing and writing lessons may consist of writing charts containing important information about concrete. These charts when fastened with attractive cords and with artistic covers make a nice exhibit on the walls. They may be illustrated by hand drawings or with pictures clipped from magazines or advertisements.

These children have no regular spelling books. For one month words relating to concrete will be hunted up and they will learn to spell them.

Compositions will be all about concrete. It may be a recounting of what the child has read, has been told, has seen upon a visit to a building being erected, or seen in educational moving pictures. But the subject matter sticks to either concrete or stone.

The cost of building with concrete is typical of the practical arithmetic problems which have replaced the old style number work.

Nature study involves inquiry into such things as materials for making cement while geography takes them to the sources.

The class in construction may spend its allotted time every day for a month in reproducing a cement plant or a miniature concrete house. Trips of inspection may be made to a concrete building under construction.

Pupils go to cement dealers and to contractors and secure samples of cement and concrete work which will be studied throughout the month.

In different forms this modern idea is being used in hundreds of schools. Example after example can be cited. Investigation at the National Educational Association Exposition in Chicago showed scores of textbooks devoted to this new method.

They call this "project" work. That means that the children plan a "project" and carry it out. They may do it through building miniature scenes of the industry, take imaginary trips to sources of supply or act out little dramas dealing with it. They have no uninteresting text-book lessons to memorize.

You and I may have had to learn to bound Siam before we knew much about the things and places nearer home. But these children learn first about what they come in contact with daily—principally food, clothing and shelter. One educator has put it aptly:

Teaching the three R's through the five F's—food, fabrics, firesides, friends and fun.

Bear in mind that no regular textbooks are used in these Cicero schools. When they are studying about concrete or anything else the children look everywhere for information about it. If a firm can furnish anything of real value it is welcomed.

Booklets from manufacturers have been used. Trips to local industries and stores have been made. Samples and exhibits of raw materials and finished products have been asked for by the school and willingly furnished by the makers. The youngsters study the newspaper and magazine advertisements for anything relating to the subject that they are following for the month.

Does this kind of education promote the use of cement? It is certain that there is much talk about concrete in the homes; enlisting the cooperation of the home is one of the platforms in the educational plank. In fact the influence of the schools upon the community is important.

Cicero has many settlements in which foreign-born parents reside. There are 28 nationalities in the schools.

But this is by no means a community of poverty-stricken foreigners. They are home-owners; building and loan associations abound. A business man would get surprising results by going up and down the streets and inquiring how many of the two or three flat buildings were owned by one of the occupants.

Why does this evolution in education concern the business man? Because these children are future users and buyers of cement. They are learning more about these things than their fathers and mothers ever did. The modern child is heard as well as seen in the home of today.

Cement Joints for Water Main

The trial of cement joints on 1,000 ft. of 8-in. pipe in Portland, Oregon, has proved so successful that cement joints have since been used almost exclusively, except where the mains must be put in use within 48 hours of the time of pouring the cement.

According to an abstract of a letter by E. D. Clark, former engineer of the Water Bureau in Portland, Ore., published in the June *Journal of the New England Waterworks Association,* the following method of preparing the cement and filling the joints has been adopted:

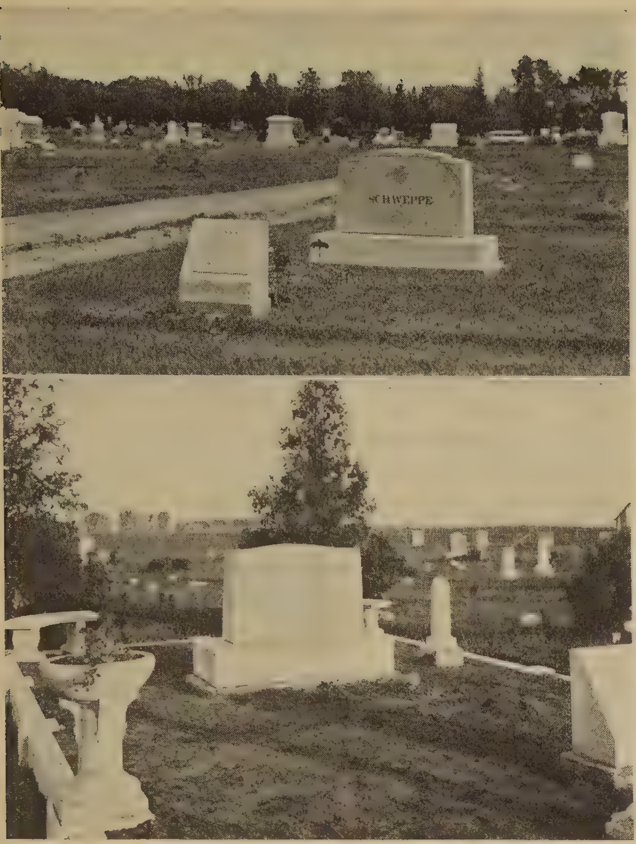
First quality medium setting cement is used, mixed so dry that the imprint of the hand will be left upon a small ball, which will crumble when let fall from the height of 12 in. The pipes should be laid upon a firm foundation, and the spacing of the spigot in the bell may be effected by placing a small bit of lead under it.

A small bit of yarn should be used, just sufficient to keep the cement from entering the pipe. After filling the bell with cement it is thoroughly compacted with a yarning iron, by hand. This will have to be repeated two or three times before the face of the joints can be properly smoothed and rounded.

Approximately 28 miles of 4-in. to 16-in. pipe has been laid in Portland with cement joints, besides which, about 4,000 ft. of 24-in. and 30-in. pipe has been relaid with cement joints during the progress of grade crossing elimination work.

In one instance referred to, where a 30-in. pipe was relaid in a concrete lined tunnel, 500 ft. or more in length, leakage was considerable at first, when the pressure was turned on. After draining the water from the tunnel two or three times, the leakage was noted to have decreased, and at the end of six months had stopped entirely, and all the joints have since remained tight.

In making colored blocks or colored concrete it is not advisable to use more than 10 lbs. of coloring to 100 lbs. of cement. Smaller percentages are better, as they affect the strength of the concrete less. Where deep colors are desired, good results may be obtained by using a sand of the color desired, as then it is not necessary to use as much coloring matter.



Example of Granette Monuments

Concrete Monuments by Granette Process

The accompanying illustrations show Granette monuments and ornamental pieces. Granette is a trade name which, according to the manufacturers, signifies a refined concrete, having the appearance of a specially fine grained granite, bush-hammered. The Granette Products Co. is doing an interesting line of work. It operates in Des Moines, Iowa, and has a dozen associate factories operating under its special patents. These patents cover a process of insert lettering and designs cast integrally and they also cover a method of surfacing or sizing the molds in which the products are made to produce a texture of bush-hammering in the finished work.

The plant at Des Moines, 88 ft. by 110 ft., consisting of main floor and basement, is of the monitor type, built and laid out not so much for volume output as for handling a limited amount of quality work, which brings a high unit price.

The company has about four hundred monuments in cemeteries in Des Moines and surroundings.

The body of Granette products is composed of washed and graded gravel, and ordinary cement in a 1 to 3½ proportion; faced ¾ to 1 in. thick, with a mix of mica crystal grit of about the fineness of corn meal, in proportion of 1 cement to 1½ grit, white water-proof Medusa cement being used.

The products are usually cast in wood molds, although in some cases plaster and glue molds are employed. Wooden molds are white pine, dressed, finished smooth and sized or filled with a specially prepared waterproofing so that they do not absorb moisture and warp.

Tamping is by hand and very thoroughly done, and products are removed from the molds as soon as finished. They are then subjected to a mist spray of water and well wet down with a hose twice a day for two weeks afterwards.

Monuments and other ornamental work, including lawn and park furniture, architectural trim stone, highway and street signs, and other letter products, are guaranteed not to crack or chip.

Lettering of monuments and other products is put in in two different ways; 90% of the work is inscribed with what the Granette Products Co. calls its velvet black. The formula for the velvet black coloring material and the method of inserting the letters is covered by patent. The aggregate used with the black is the same as for the facing of the monument proper. The letter is inlaid in the face of the stone ⅜ in. thick at the same time the stone itself is made. It becomes integral with the rest of the work. However, cut inscriptions are provided when they are wanted. Both types of inscriptions are shown in the illustrations.

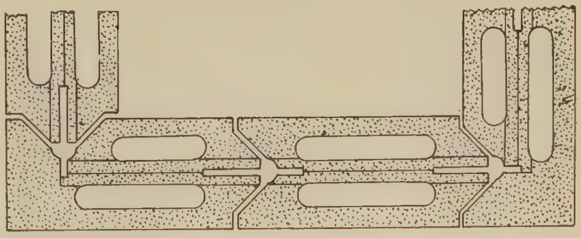
Some of the stone made are from 2,000 to 3,000 lbs., and are handled chiefly with lift jacks upon which they are rolled about from one place to another. Stones are also moved on what the Granette people call their hand barrows, made of 2 by 6 timbers clamped on to the sides of stone with handles extending beyond and padded where the boards come in contact with the stone.

By means of associate factories, of which there are twelve in Iowa, all operating under the same patents, it is possible to handle business over a large territory without the disadvantage of shipping products a great distance or sending men a long distance to set them up. I. T. Stelle is general manager.

Colosimo Air-Space Block

The arrangement of air spaces is the basis of a claim of damp-proofness and insulating value in the Colosimo block, developed in Gary, Ind., by the Colosimo Damp-Proof Building Block Co.

A horizontal section of a partial course of these block is shown in the accompanying illustration. Mr. Colosimo designed the block, on which he has a patent and has developed a machine for its manufacture. He has manufactured a good many block, which are in use in several buildings in Gary, and Mr. Colosimo has good testimonials of the satisfaction which they are giving.



The block are intended for use without furring strips on the inner surfaces of exterior walls. One feature of the block is a lug and groove joint at the ends to insure good placement, and at the top of each block there is a trough or depression in the center wall to give longitudinal air space or to provide space for horizontal reinforcing. The block are made in a side face machine, hand operated, with the cores working up and down.

Stucco on Metal Lath as a Fire Safeguard

Recent tests on metal lath-stucco construction at the Underwriters' Laboratories, Chicago, demonstrated that this construction would withstand a fire of duration and intensity equal to that of the Burlington building fire in Chicago recently, which was without doubt more destructive than any fire likely to occur in a residence or in most mercantile establishments. These test results were given by Wharton Clay, commissioner of the Associated Metal Lath Manufacturers, in a paper read before the Building Officials' Conference held in Indianapolis recently. While not championing a compromise with perfect safety, he pointed out that it would be a good deal better if we can't have fireproof buildings, to construct buildings of stucco and plaster on metal lath, or at least have the vulnerable points of the interior protected by this type of construction.

Mr. Clay pointed out that the insurance rating on a house is not always a sure indication of its safety to life, because this rating depends more on the salvage value of the building. He showed that while the lower insurance rate on masonry has led many people to feel greater security from fire in a masonry than in a frame house of the same interior construction, they are about equal in regard to safety to life.

Metal lath can be used on the vulnerable parts of a building—over the furnaces, in closets, around flues, staircases, bearing partitions, and the inhabited floors, at a cost of less than 2%—less than the interest charge for four months occupancy—and give a safety to the dwelling that is possibly the next best thing to complete fireproof construction.

Vibrated Concrete Products

The Vibrated Cement Products Co., Fresno, Cal., makes face brick with water heated to 90° F. for quick hardening, and employing a vibrating platform for the molds.

The vibration is accomplished on a table which has no vertical movement, but which vibrates through a space of ¼ in. horizontally at a rate of 280 vibrations per minute. Vibration is continued for two to three minutes. The mixing water is heated in a small boiler containing a 380-ft. coil of 1-in. pipe. Only a small amount of fuel is required to furnish 250 gals. of water per day at the required temperature of 90°. The temperature is controlled by the thermostat at the mixer.—*Concrete Builder.*

Advertising Concrete Block

The advertisement for concrete block shown in the illustration, and others, with the heading translated into French, Spanish, German, Portuguese, Italian, Swedish, Finnish, Russian, Persian, Armenian, Arabic and Japanese, have been prepared as suggestions for an advertising campaign for block manufacturers. The Portland Cement Association is responsible for the execution of the idea. It is intended to attract chiefly by its novelty and not because of any necessity to use the various languages.

A *Turk calls it:*

"داشلونمش کراجه"

(Dash-lon-mush Cara-age)

but we call it by the more familiar name of

Concrete Block

The increasing demand for this popular building material is due to its beauty in a finished structure.

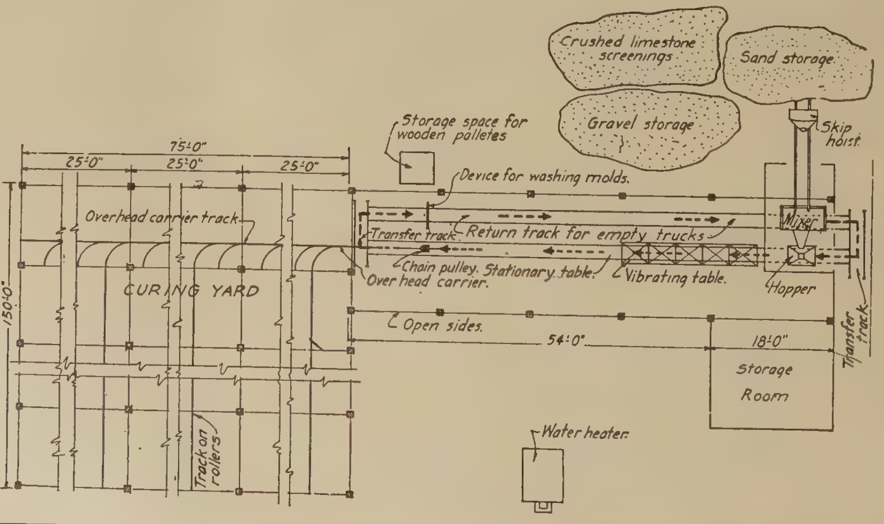
Aside from its beauty, it is (1) permanent, (2) fire-safe, and (3) low priced.

Use it for homes, garages, and business houses!

Buffalo Concrete Products Association

Concrete Block Advertisement Prepared by the Portland Cement Association

Factory Plan, Vibrated Concrete Products Co.



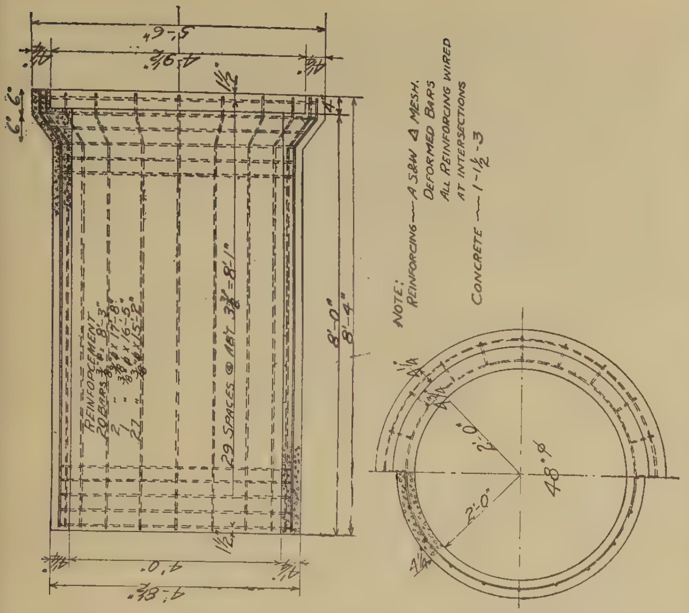


FIG. 1—DESIGN OF PIPE BEING MADE BY BANGOR CAST STONE PRODUCTS CO. FOR MAINE CENTRAL RAILROAD

Making Concrete Pipe for Maine Central Railroad

The Bangor Cast Stone Products Co., Bangor, Me., has been manufacturing 5,000 ft. of reinforced concrete pipe for the Maine Central Railroad. Most of the pipe was made last winter indoors, but operations were shifted outside in the spring. This enabled the company to keep its best men through the winter.

The pipe are cast in 4 and 6 ft. steel molds, manufactured by the Raber & Lang Manufacturing Co., Kendallville, Ind., using a wet 1:2½:3 mix. Washed torpedo sand and washed and screened crushed gravel are the aggregates. The reinforcement consists of A. S. & W. Co. steel wire reinforcing rolled to the proper diameter on a bench made with three rollers with a system of pining holes to hold the upper roll frame to the proper diameter. It is similar to the apparatus with which blacksmiths used to roll steel wagon tires, and works very economically.

The pipe are left undisturbed for 48 hours, after which the cores are pulled with the assistance of a block and fall mounted on a portable tripod.

The finished pipe are handled with an A-frame carry-

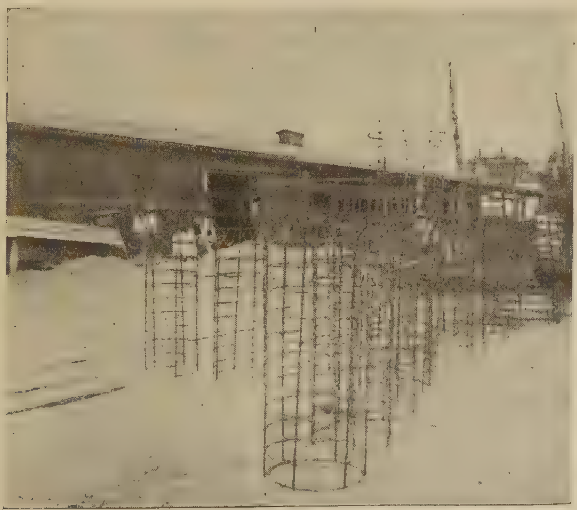
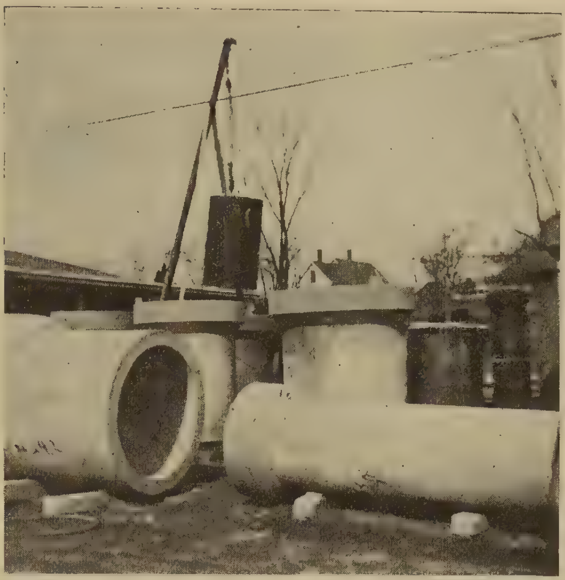
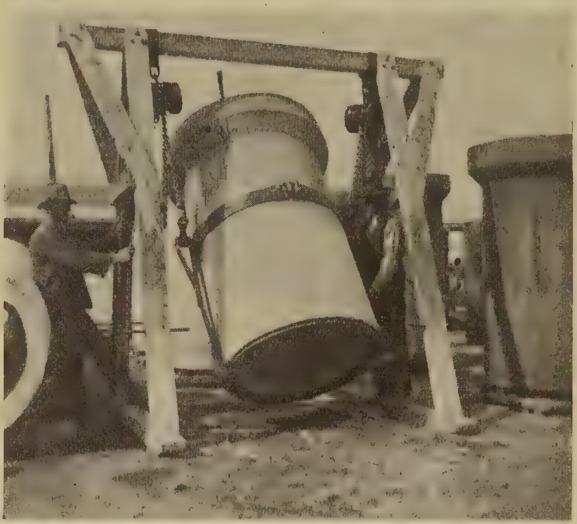


FIG. 2—REINFORCEMENT CAGES MADE UP READY TO BE DROPPED INTO MOLDS





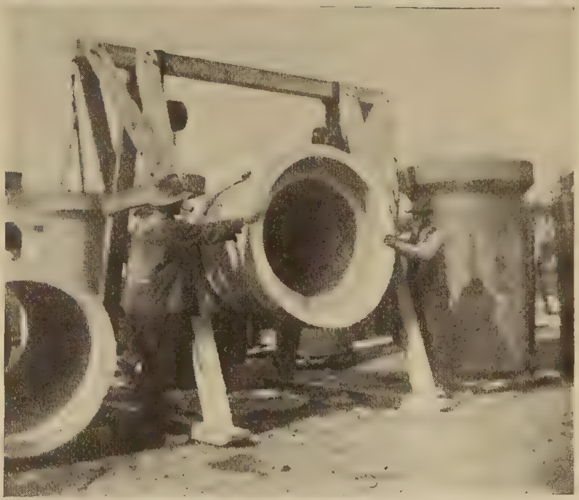
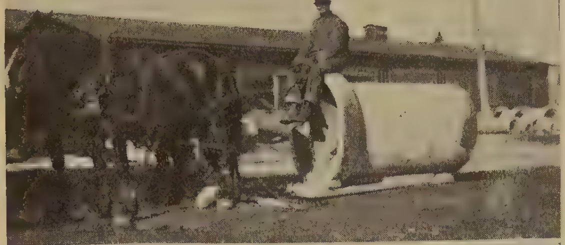


FIG. 3—PULLING CORE MOLD AFTER 24 HOURS

FIGS. 4-5—HANDLING FINISHED PIPE



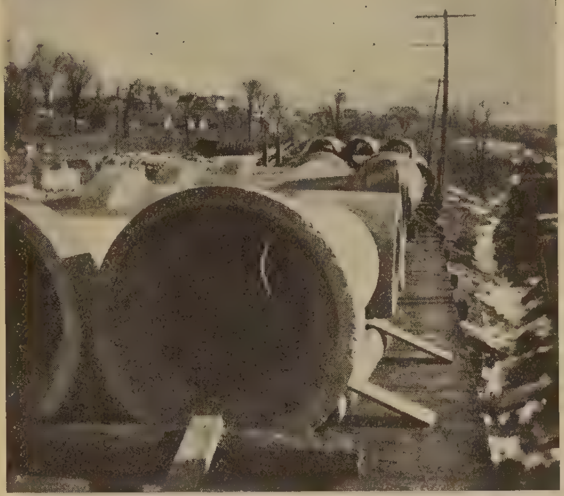


FIG. 6—MOVING PIPE ON SKIDS
FIG. 7—BLOCKED ON FLAT CARS FOR SHIPMENT

ing two $1\frac{1}{2}$-ton Triplex[1] chain hoists. The pipe are lifted, the skid parbuckled to the car with a block and tackle attached to a $1\frac{1}{2}$-ton Mack truck, and loaded by a small derrick.

The force engaged in making pipe consists of two men at the mixer, two men wheeling concrete, one man placing concrete, two men puddling concrete in the molds and one foreman. This crew sets up 16 lengths of pipe per day, including all labor, such as stripping and oiling molds, setting up and casting. With a double set of pallets, molds are used every day and pipe moved only after 48 hours.

The company has succeeded in interesting the State Highways in the use of concrete pipe for culverts.

Have California Concrete Roads Failed?

The *Portland* (Ore.) *Telegram* says (June 30, 1922):

"Whenever a concrete highway for any good and sufficient reason shows weakness or failure, the black-top interests scent the trouble from afar, as crows scent a carcass. California's 1,500 miles of concrete roadway, laid of too thin a slab, is now drawing destructive criticism from the asphalt interests.

"California, it will be remembered, in order to cover its long distances with paved roads, laid 4-in. and 5-in. pavement when 7 in. should have been the minimum thickness. Yet in spite of this error in engineering, the United States Bureau of Roads, through its chief, Thomas H. McDonald, has this to say regarding the pavement:

People say that the roads of California have gone to pieces and that they have been gradually giving up the ghost. The Bureau made a very careful survey of 1,290 miles of the entire system of 1,500 miles of concrete roads which have been built in California since 1909, that is, a period of over ten years. In that ten-year period, of the entire mileage that has been built, less than 13% is all that has shown signs of distress or has broken down; and those roads were 4 or 5 in. thick and 70% of them were laid over clay or adobe soils."

Road Finishing Methods in Washington

The Washington State Highway Commission has evolved a system of highway surface finishing which produces a road with very good riding qualities. The contractor is required to equip himself with a set of tools designed by the Commission and use these in the specified manner.

The finishing, which is carefully watched by inspectors, is governed in every case by standard methods. These are described in the *Concrete Highway Engineer*. Concrete is struck off with a standard "crown" template which is worked backwards and forwards in short strokes, and up and down to tamp the concrete. Long strokes, tending to tear the surface of the pavement, are not permitted.

After being struck off, the concrete is rolled with a standard iron finishing roller. This operation removes excess water, embeds the larger pebbles, and produces a film of mortar which will finish readily. Immediately following the roller, the surface of the pavement is thoroughly floated with the standard long-handled wooden float.

Following this operation and before the pavement has become hard or sticky, the final finish is given with a standard finishing board. This board extends entirely across the pavement, with a handle at each end. The finisher, with the help of a workman, moves the board slowly and with a continuous motion across a full panel. The board must be moved back and forth, usually from three to five times, before a smooth, uniform finish is obtained.

To overcome the slight displacement which sometimes occurs at expansion joints because of the use of the finishing board, a straddle float, also of standard design, is used on all joints immediately following the final board finish. All float marks are taken out with a hand float, and all exposed edges are rounded with an edger having a $\frac{1}{2}$-in. radius. Joints are finished with a $\frac{1}{4}$-in. edger.

For rough concrete forms, green lumber is often preferable to kiln dried or seasoned lumber. Seasoned lumber generally warps out of shape when wet by the moisture from the green concrete.

No exact time schedule can be set for removing forms from concrete, as there are so many factors that enter into the question, such as the consistency of the concrete and the conditions of the atmosphere at the time the concrete is poured. The nature of the stress that the concrete will be called upon to withstand after the forms are removed is also of vital importance.

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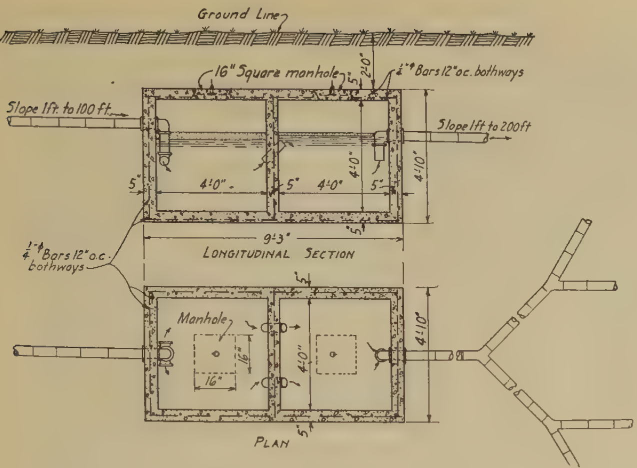
[1] Yale & Towne Manufacturing Co., New Haven, Conn.



Ground Plan and Vertical Section of Satisfactory Septic Tank

Septic Tanks

Farmers in Napa County, Cal., have come to a realization of the value of septic tanks in doing away with the unsanitary privy, and within the last six years have built 1,550 concrete septic tanks, according to reports to the Portland Cement Association. Some farmers have as many as three tanks on one ranch, each house on the place being connected to a separate tank. To date we have received no complaints from any of these, and all who have installed them are more than pleased with the equipment.

The accompanying details show the tank in general use in this county. The top, bottom and walls of the tank are built of concrete 5 in. thick. There is a concrete partition between the first and the second compartments of the tank. The sewage is carried from the first compartment to the second compartment by a 4-in. tile set in the concrete partition at an angle of 45 degrees, with the lower end not less than 14 in. from the bottom of the tank, and its upper end not less than 14 in. from the top of the tank, the upper end of the tile being in the second compartment. This tile is placed in this manner so that the flow through it will not disturb the sludge in the first chamber, or the scum in the second.

The bacteria which decomposes the sewage in the tank is present in all sewage, but a tank of this kind is essential to complete decomposition. Lye and strong disinfectants should not be thrown into the sewer, since such material would destroy bacterial action in the tank. Nor should storm water from the roofs of buildings be run into the tank.

In California, where the climate is mild, these tanks are built with the top on the surface of the ground. But where extremely low temperatures prevail, the top of the tank should be protected by a covering of about 2 ft. of earth.

This type of septic tank is easily constructed and, being built of concrete, will last indefinitely. Tanks of this type have been in operation for eight years and have never yet been opened. Possibly some day in the future it will be necessary to clean out the sediment. For this purpose, manholes are left in each compartment, so that it can be cleaned.

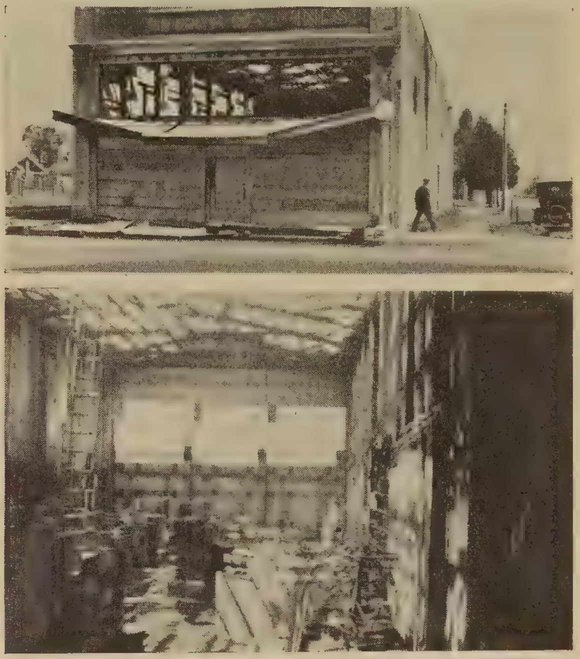
Aggregates used in mixing concrete are generally classed as fine or coarse. A fine aggregate is one the particles of which will pass through a screen with ¼-in. openings. Aggregate retained on the screen is classed as coarse aggregate.

Wood Interior of Concrete Building Destroyed by Fire

The accompanying illustrations show the undamaged condition of the exterior concrete walls of the warehouse and office building belonging to the Bass-Hunter Paint Company, in Fresno, Cal.

According to reports of the fire, April 14, 1922, the combustible interior was completely burned out, and roof, office, windows and inside finish, as well as the entire contents of the street floor, destroyed.

The fire is supposed to have started from an explosion in a gas stove in the office. Efforts of the firemen kept the flames confined within the concrete walls of the structure. The fire also was prevented from entering the basement of the building and the entire stock in the basement was saved.

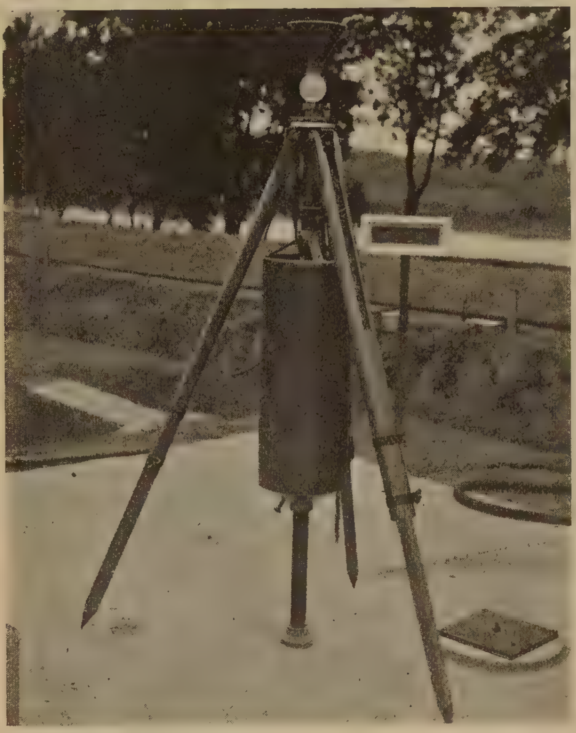


Outside and Inside of Concrete Wall Building After Fire

It is just as true of concrete buildings as of other types of construction that fireproof exterior walls alone do not constitute fire-safe construction. It is quite as necessary to have reinforced concrete floor slabs and roof slabs and some form of fireproof partitions as it is to have fireproof exterior walls, if serious interior fires are to be prevented. In this instance, as in a number of others, the slight additional cost of reinforced concrete floors and roof would have saved this company serious embarrassment.

Harrison F. Gonnerman has joined the staff of the Structural Materials Research Laboratory, Lewis Institute, Chicago. Mr. Gonnerman graduated from the Engineering College of the University of Illinois in 1908, and is author of a number of papers before the American Society for Testing Materials.

Bearing Power of Soil Determinator



To measure and compare the bearing values of the various types of subgrade soils, the Bureau of Public Roads of the United States Department of Agriculture has designed and built an apparatus which has promise of good results.

The apparatus is simple in design, light, easily built, and is capable of measuring the bearing value of almost any soil containing an appreciable amount of moisture.

It may be operated by one man with two helpers, and offers a suitable means of securing valuable information as to the load-carrying capacity of subgrade soils before pavements are laid.

The general appearance of this apparatus is shown in the accompanying cut, and it has only four separate parts, tripod, shot container, with bearing foot, shot funnel, and Ames dial. The load is applied by pouring measured quantities of fine shot into the funnel at regular intervals, while the penetration of the foot into the subgrade is indicated by the Ames dial mounted above the tripod head.

To operate the apparatus, the tripod is set firmly in the ground and the shot container with foot is brought to a truly perpendicular position as determined by the small level shown just above the shot container. By a slight movement of the bearing foot, the direction of the load to be applied is made perpendicular to the subgrade.

The shot funnel is next placed in proper position at the top of the tube and the Ames dial clamped to the tube with the dial foot resting on the top of the tripod head and when the dial is adjusted to read zero all is ready for the test.

Know Thy Costs

The three qualifications of a successful contractor are business ability, knowledge of construction and financial responsibility, says P. M. Jones, of Mebius-Jones Co., in a *News Letter of the Associated General Contractors.*

The second of these, knowledge of construction, covers a field involving technical or practical training and years of experience. What should that much abused word experience imply? Should it mean that having served a term of years in a certain line of work, a man should consider himself experienced in that work? To me, an experienced contractor is one whose judgment is sound on the methods of construction and on values, but this must involve some means of determining the proper methods or values. One very important factor in the determination of labor values is the proper keeping of labor costs. How many contractors keep their costs? Some think they do, but the haphazard keeping of costs is more dangerous than no cost-keeping whatsoever, as it may tend to warp otherwise good judgment.

It must be admitted that the keeping of labor costs involves some extra work and effort, but it is work and effort well expended, and is absolutely necessary to sound contracting in the future. Proper records are becoming more and more necessary and valuable in every line of business.

So let's quit writing on our cuffs and get down to brass tacks. Can you conceive of a contractor who knows his costs and how to apply them clamoring for the cost-plus system? Or can you imagine a contractor who blunders along with a good "line" of talk and who has no confidence in any estimate he might prepare, putting up any kind of a successful fight against the first mentioned class of contractor?

You must, of course, first get your job. The old recipe, "How to Cook a Goose," which starts off with the direction "first catch the goose," may be remembered. It is impossible to keep costs without a job. BUT—if it is likely that you lose your right hand in capturing the goose, your appetite for goose will very likely disappear.

The illustration shows how bolts were held in the form for a concrete base for farm lighting equipment. The bolts are 6 in. long and project 3 in. above the top of the finished concrete. The concrete for this base was mixed in the proportion of one sack of cement to 2 cu. ft. of sand to 3 cu. ft. of pebbles.—*Concrete Builder.*

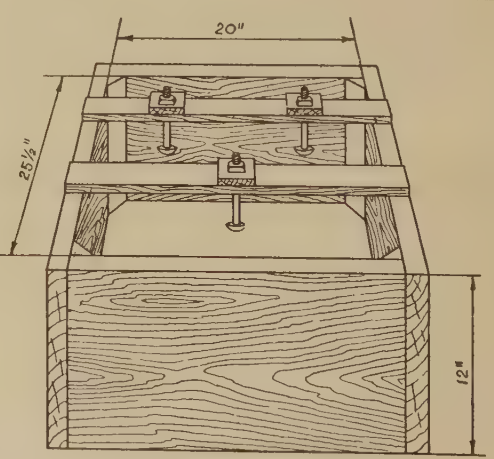


Fig. 1—Form for Motor Foundation

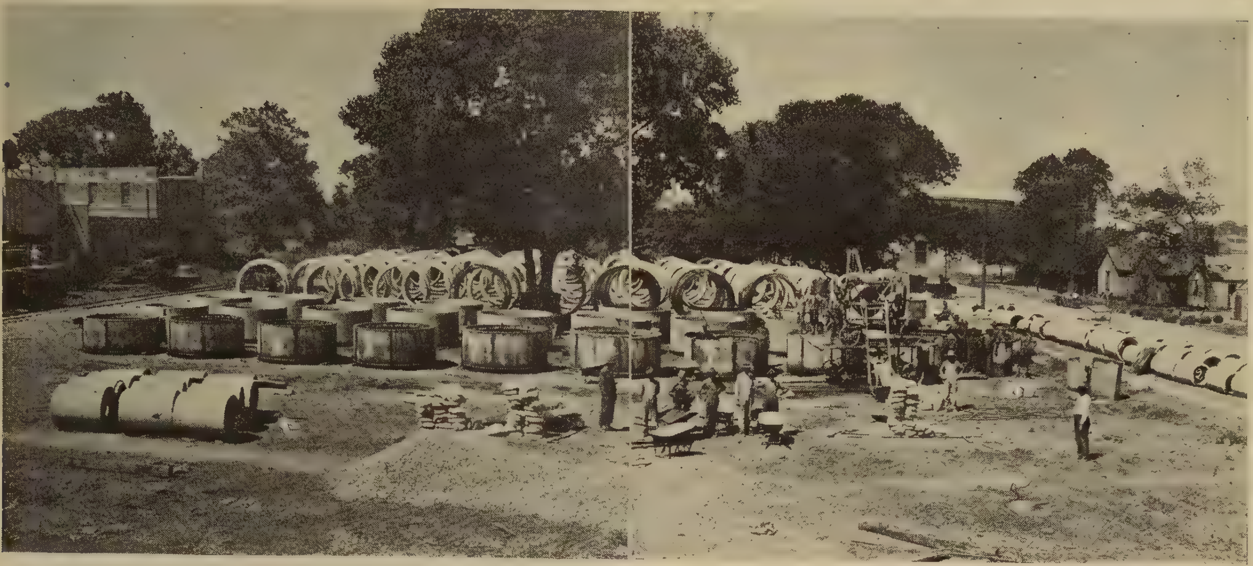


Fig. 1—Casting Yard of Independent Concrete Pipe Co., Oklahoma City. Accurate and Heavy Steel Molds Are Used and the Pipe Protected in the Molds Against Too Rapid Drying

Oklahoma City Concrete Sewer System

Oklahoma City recently voted a $2,000,000 bond issue for the improvement and extension of its sewer system. Although sewer specifications in Oklahoma City had never been open to concrete pipe until last February, the new material was carefully investigated by city officials and the first section of the work, amounting to more than 8,000 ft., was awarded to concrete at a saving to the taxpayers.

This work includes 5,500 ft. of plain sewer pipe of various diameters ranging from 15 in. to 24 in.; 220 ft. of 78-in., 1,285 ft. of 90-in., and 1,036 ft. of 98-in. reinforced concrete pipe. The smaller sizes now in competition with the so-called "double strength" clay. For the larger diameters only reinforced concrete pipe was specified.

All of the smaller concrete pipe was manufactured by the Zeidler Concrete Pipe Co., Joplin, Mo. The reinforced pipe, including all of the material above 24 in. in diameter, was manufactured in Oklahoma City by the poured process by the Independent Concrete Pipe Co., of Indianapolis.

Accompanying illustrations give an idea of the scope and significance of a large sewer pipe installation of this character. City Engineer Hart is giving the installation careful personal inspection.

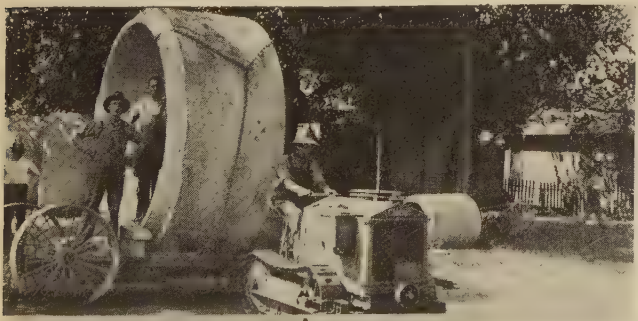
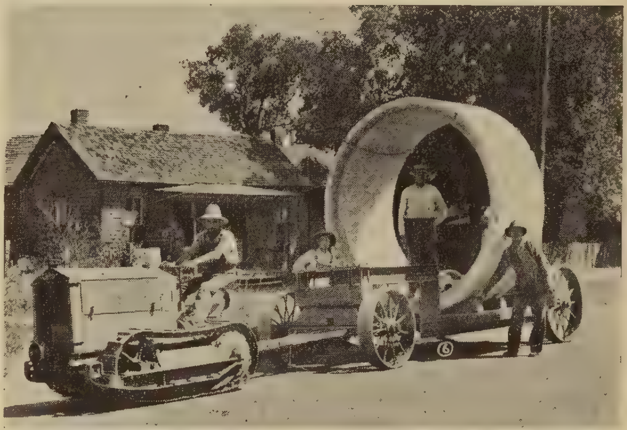


Fig. 2—Towing a Section of Pipe Aboard a Truck—An Easy Operation With the Aid of the Small Tractor (Cletrac)



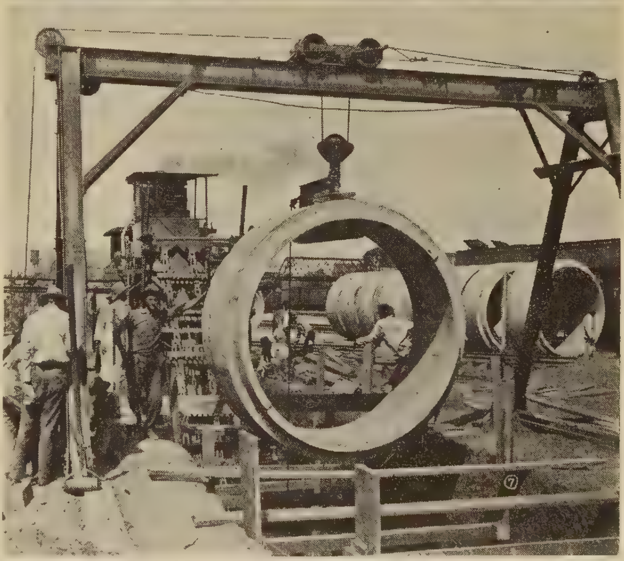


Fig. 3—Hauling the Pipe by Tractor to Point of Installation

Fig. 4—Laying 96-in. Reinforced Concrete Pipe in the Oklahoma City Sewer System

The traveling craneway and other equipment are plainly shown. Concrete pipe sewers are often preferred in congested districts because of the short length of open trench required and the opportunity to back-fill almost immediately.

Making Lock-Joint Centrifugal Pipe

Reinforced concrete pressure pipe for water supply purposes are being made by the centrifugal process by the Lock Joint Pipe Co., of Ampere, N. J., at its plant at Ampere, for a job in New Jersey, and at its plant at Denver, Colo., for the city of Greeley.

In adopting the centrifugal method for the manufacture of some of its pipe, the Lock Joint Co. built up its own apparatus, different in many respects from that which has been used in the production of centrifugal pipe abroad. On various features of this equipment it has applied for patents. The methods employed in the manufacture are shown in the accompanying illustrations, from photographs, part of them made at the Denver plant and part at Ampere.

A reinforcing cage is built up on a steel mandrel cylinder, over which is first wired a triangular mesh reinforcing. To this, longitudinal rods are fastened, and over the longitudinal rods a spiral of circumferential reinforcing is fed from a reel behind the mandrel, as shown in one of the illustrations. The mandrel is borne on a car, which is pulled backward automatically as the spiral is wound. The illustration shows the mandrel three-quarters withdrawn from the cage.

The cage having been formed, is lifted by crane and set into half of the pipe mold. The mold, as is clearly shown in the illustration, is divided in halves longitudinally, and when the two parts are joined by wedges and keys, closely spaced because of the tremendous pressure involved in the centrifugal method of manufacture, the unit is then ready to be inserted in the centrifugal machine. The joints have to be made tight by cotton wicking. It will be noticed that when the two halves of the mold are placed together sheaves are formed, in which the rotating cables operate.

The centrifugal pipe thus far is made in but two sizes, 27 in. and 20 in. diameter. The 27-in. pipe, 12 ft. long, are being used on the Greeley job, and 20-in. pipe, 12 ft. long, on the New Jersey job. When the reinforcing and mold sets are assembled the entire unit is picked up by the crane and placed in the cable-sling between idlers for guides, as clearly shown in the illustrations.

Thus far it has not been found practicable to cast pipe centrifugally using a coarse aggregate, the centrifugal force having a tendency to throw all of the coarse particles to the outside with insufficient mortar. A rich mortar mix is therefore used. This is mixed in an ordinary batch mixer, dumped into a cone-shaped hopper with a modified ball-valve control, similar equipment being used in the manufacture of large concrete pipe in the ordinary way. The contents of this hopper are dumped into a large steel pan, the sides being hinged to lift upwards so that the mortar may be scraped with hoes into a cylindrical hopper with a 2-in. slit down its full length. This cylindrical hopper is of slightly smaller diameter than the interior of the pipe. When the hopper is filled with the proper amount of mortar for the production of a pipe, it is shoved forward by ingenious equipment, which must support it entirely from one end, slung from an overhead rail. The slit in the hopper at this time is on top, the mold is then revolved and as the desired speed is obtained, 300 r. p. m., the hopper is turned slowly, distributing its contents over the entire inner surface of the mold.

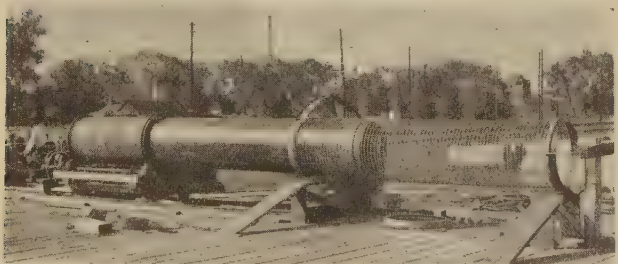
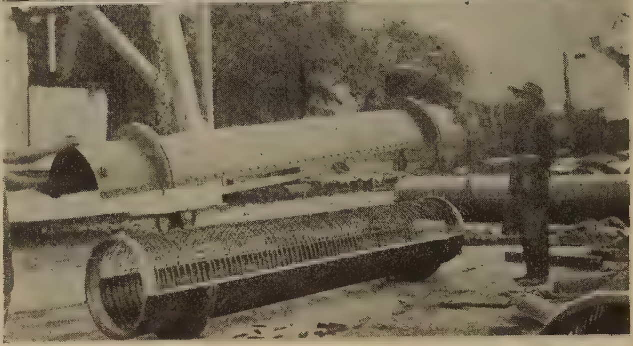


Fig. 1—Forming the Reinforcing Cage



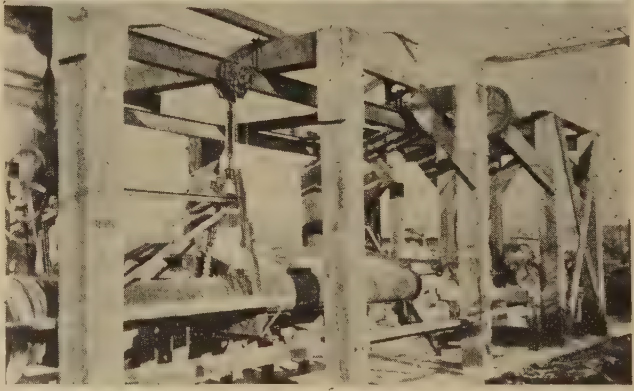


Fig. 2—The Mandrel Is Motor Operated

Fig. 3—Joining Halves of Mold, with Reinforcing Inside

Fig. 4—Lifting Mold Into Slings of Centrifugal Machine

Fig. 5—The Cylinder Shown Is the Hopper from Which Mold Is Filled

The mold is revolved for fifteen minutes. After about five minutes the centrifugal action has so compacted the mortar against the mold shell that a great deal of sur-

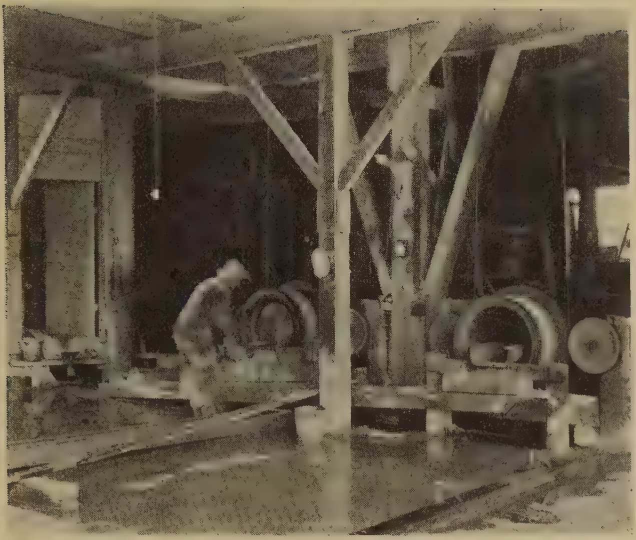


Fig. 6—"Spinning" Pipes

plus water remains on the inside. This is removed by an ingenious method. A long sheet iron trough is shoved through the revolving pipe, supported at either end, outside the revolving mold. The expert pipe maker then takes a long-handled brush, the brush being flat, made of wires about 4 in. long. He rests the handle of the brush, by means of a hook, upon the right hand edge of the trough, and by shoving it in and out allows the brush to play against the interior surface of the pipe, which is being cast in such a way as to force the surplus water in a stream down the brush into the trough, from which it is conveyed to a wheelbarrow at the end of the pipe. The use of the wire brush in this way is followed by the use of a fine bristle brush until practically all surplus water has been taken out. Then in order to secure an impervious interior surface, a rich grout mixture is poured into the interior of the pipe, from which the surplus water is in turn removed. At the end of fifteen minutes machinery is stopped and so completely has excess water been removed and so tremendous the pressure exerted by centrifugal action, that the concrete is so stiff as to resist firm pressure of the fingers.

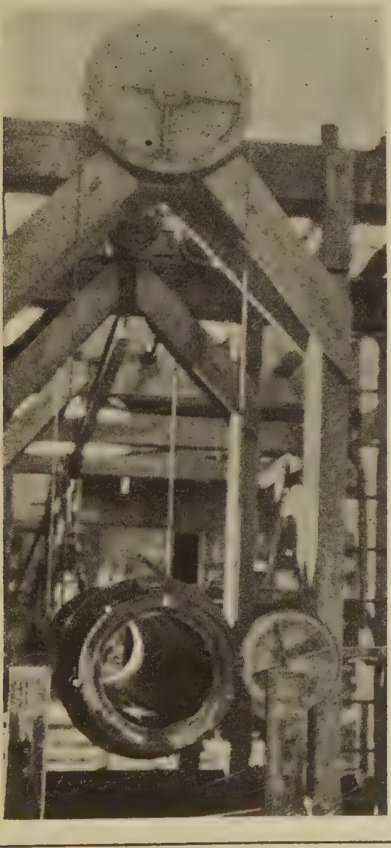


Fig. 7—A Close-Up of Cable Slings and Pulleys by Which Molds Are Revolved

Pipe made in this way are being used on the New Jersey job in continuation of an iron pipe line—a standard iron pipe joint section being cast in the end of the pipe which couples up the two parts of the job, thoroughly demonstrating the feasibility of hooking up a concrete pipe line direct with an old iron pipe line.

The joint being used on these pipe is similar to a joint used on other Lock Joint pipe previously described in this magazine. Small lead pipe with a fiber lining is placed in a slight recess on the inner surface of the socket end and when the spigot is driven home in the trench a tight and elastic joint is made without the use of any mortar or grout.

The density of the pipe made by the centrifugal method is its remarkable characteristic. The inner grout surface when hard is of the greatest smoothness and hardness. The molds are removed from the pipe in from 24 to 48 hours.

The scouring action of the centrifugal process when the wet mix is put into the molds requires the use of something very much heavier than the ordinary form oil. Ordinary crude petroleum is mixed with a stiff petrolatum, brushed on while warm. This heavy coating of grease on the outer surface of the pipe when removed from the mold prevents quick drying and aids considerably in properly curing the pipe. When removed from the machine temporary metal bulkheads are fastened in the ends of the pipe with canvas gaskets so that all of the moisture remaining in the concrete as it comes from the machine is retained for proper curing.

Reinforced Concrete Rowboat

Reinforced Concrete Boat Constructed by T. A. Brouwer

The illustration pictures a reinforced concrete boat constructed by T. A. Brouwer, Westhampton, N. Y. This boat is built up on metal fabric over a light wood inner mold by plastering concrete on by hand, placing wire mesh reinforcing and plastering over it. Larger boats Mr. Brouwer would build in the same way by building up a required thickness through successive layers of concrete and reinforcing. The mold is made of light lumber built up to any desired pattern or built around any model it is desired to imitate.

Progressive Block Maker Has New Machine

V. H. Pettengill, Rock Rapids, Iowa, who has been a successful block manufacturer for more than a dozen years, has developed a machine of his own which he has been using with success for the last year and a half. The equipment consists of a tamper, mounted above a mold box, in the same frame with a hopper which moves from a position over the mold box to a position back of it, where it is filled by one operator while the other operator removes the block. The block are stripped out of the mold box by placing a presser foot upon the top of the block to hold it in place, while the box moves upward. Then the block is released by an automatic device and swings automatically to a position out of the way of the tamper, while the mold box goes back to the position for tamping. The hopper is designed to let the tampers work down through it and by a movement of a lever introduce more concrete to the mold box after the bottom of the block is tamped. The power that runs the tamper raises the mold box and it returns by gravity.

Special advantages of the equipment claimed by Mr. Pettengill are: speed with which the block can be made—since the machine has been producing 80 or 90 block an hour; the weight of the block, the design of which is shown in the accompanying sketch, is 40 lbs. for the standard 8-in. by 8-in. by 16-in. size; concrete for the block can be used at a consistency wet even for a stripper machine; because the block itself are held firmly at top and bottom while being stripped out of the mold; pallets are of low cost, as they are made out of wood and do not have to be absolutely exact as to size; unusual density by reason of the tampers operating through the hopper down into the mold box, feeding additional concrete while the tampers are in motion.

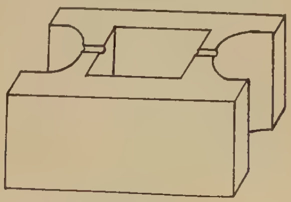


FIG. 2—NEW PETTENGILL BLOCK

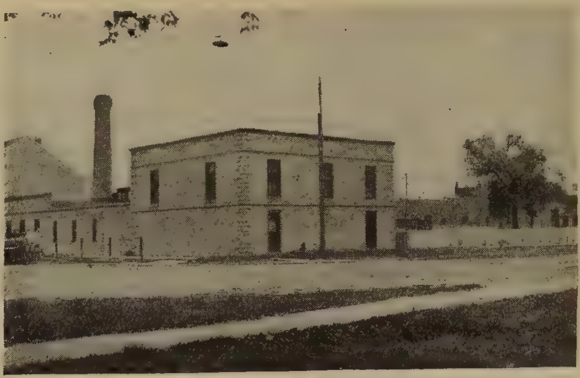


FIG. 1—THE PETTENGILL CONCRETE PRODUCTS FACTORY

The last heard from Mr. Pettengill his machine had not been developed to that point where he was ready to put it on the market, although he has been using it satisfactorily in his own work.

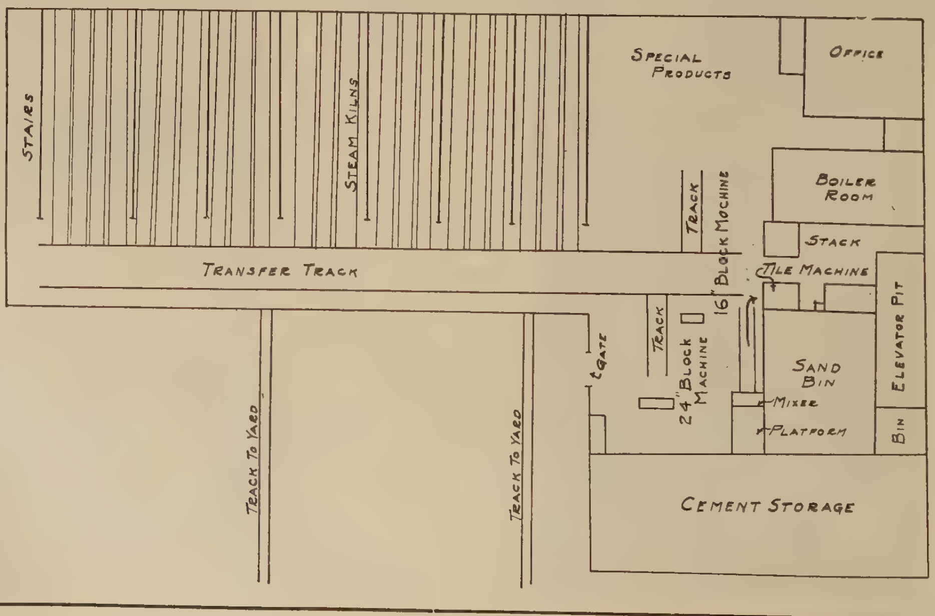
Mr. Pettengill has found that manufacturing a consistently good product and endeavoring to please the customer by building good houses, is a far greater aid to business than merely trying to sell the block.

In the winter, when most of his customers are planning their houses and it is difficult to get out and inspect the finished buildings, he uses an attractive display of photographs of buildings of each class that he has constructed and these materially help in deciding the prospective builder to use concrete block.

The attractive appearance of Mr. Pettengill's factory is also a big factor in influencing prospective customers. Its layout is illustrated in Fig. 3.

Steam is not used for curing, although the plant is so equipped. It is used only for heating.

FIG. 3—LAYOUT OF PLANT HIS BUILDINGS ARE OF ROUGH PLAIN BLOCK, FINISHED WITH STUCCO, A PLEASING COMBINATION FOR COMMERCIAL BUILDINGS



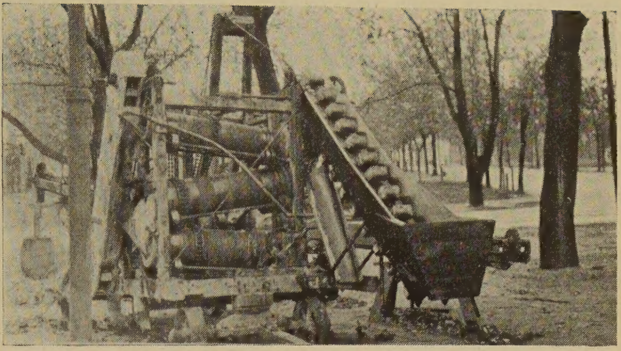
New Steel Forms and Continuous Mixer on Cleveland House Job

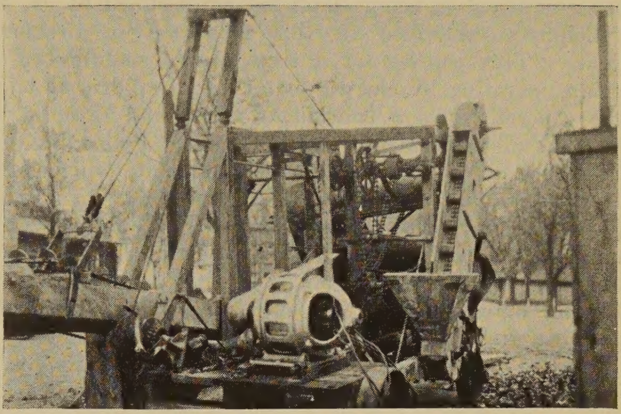
A two-story house, 20 ft. by 36 ft., is being erected with concrete walls and floors adjacent to Euclid Beach Park, Cleveland, by the Lambie Concrete House Corp., for D. S. Humphrey. This work involves the use of a good deal of new equipment.

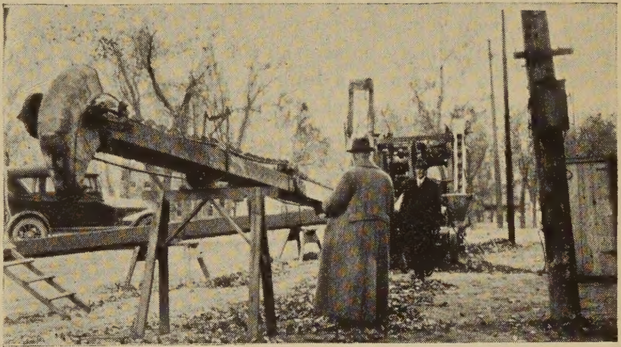
Some time ago the Lambie Concrete House Corp. was organized, with J. Edward Lambie, president, to develop house building methods and equipment, starting with the re-design of the Lambie system of steel forms, with which the readers of CONCRETE who have followed the subject of house building are more or less familiar. The original Lambie forms were in narrow pan-shaped units, of story height, and were employed on a number of house jobs which have been described in this magazine. They developed as their chief drawbacks, an excessive unit weight.

The new forms now in use overcome this difficulty by providing a very much lighter unit, adaptable to great variety of designs by using form sections of a number of standard sizes. Each form unit (and several of these may be seen in an accompanying illustration), is in the pan form, reinforced with cross webs to give additional strength and stiffness, because of the lightness of the metal, and punched for tying together on the work with very simple small wedges and keys. These new units are made 9 in. wide by 6 ft. long, also in lengths of 3 ft., 2 ft., 1 ft., 9 in., and 6 in. They are also made 6 in. wide in lengths of 6 ft., 3 ft., 2 ft., 1 ft., 9 in., and 6 in. The 6 ft. by 9 in. standard unit, which does most of the work, weighs about 40 lbs., the others in proportion. The old form unit in story height length 9 in. wide, weighed 110 lbs., and some of the cornice and belt course units were considerably heavier. The new units are made in such a way that they may be fastened together either horizontally or vertically to build up the necessary forms inside and out interchangeably, as a child might set up building blocks. The walls are lined and supported with two or three lines of 3 by 3 angles, depending upon the span. The same units are used for floor forms, also supported on angles. As a usual thing the units are set up to form a wall first by placing two rows at the bottom in horizontal position, spaced for the required wall thickness, then the vertical units are set up on them and more horizontal courses placed above, thus giving a very satisfactory method of tying the whole form structure together, above, below and around the openings. With the units in widths of 6 in., 9 in., 1 ft. and so on, it is possible to arrive at any arrangement of dimensions desired in multiples of 3 in.

On the house near Euclid Beach, it is reported by Mr. Lambie that a foreman with four laborers set forms for an area of 20 by 12 ft., equaling 240 sq. ft. of floor, in just 11 minutes. A few days previous four ordinary Italian laborers, at 36c per hour, and with two foremen, set up the wall forms at the rate of 2 sq. ft. per man per minute for a total of 301 sq. ft. in 17 minutes, including corners.







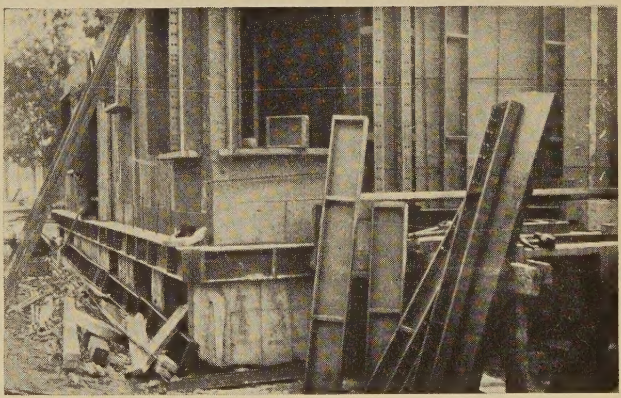


FIG. 1—THE HUMPHREY MIXER USED IN LAMBIE HOUSE WORK—NOTE THE THREE INCLINED CYLINDERS—GRAVEL IS PROPORTIONED FROM HOPPER AT RIGHT AND CONVEYED INTO TOP CYLINDER

FIG. 2—THE DELIVERY END OF THE MIXER—CEMENT IS PROPORTIONED FROM HOPPER AT RIGHT

FIG. 3—THE DELIVERY END OF PLACING EQUIPMENT

FIG. 4—THE NEW LAMBIE STEEL FORMS IN USE

October 12, on the house near Euclid Beach, a record was made for casting a complete story, including walls, floors, partitions and chimneys, in 2 hours and 25 minutes. This included the first story slab. The basement slab was previously cast and served as the base, upon which forms were set up, reinforcing having been used around the basement floor. This wall and floor were poured in 2 hours and 25 minutes. The first floor slab, 6 in. thick, was poured in 32 minutes.

The speed of a job, however, is very frequently slowed up by some one detail. In this case it is a matter of insulation, on which experimental work is being done, lining the forms with Celotex in large sheets about $3/8$ in. thick. This is a fibrous, cellular material made from the waste of sugar cane. In the present experimental work it is being coated with a hot asphaltic mixture and fine gravel, thrown on as an interior waterproofing precaution and as a means of securing bond. This work has progressed a little slowly, and the methods employed for using this insulating material believed to be excellent in itself, will probably be changed to speed up the work.

On the Lambie job it is interesting to note that placing equipment is being employed as designed by D. S. Humphrey, described in this magazine in previous years. This consists of a trough with paddles on a chain operating by electric motor very rapidly, to take the concrete from a continuous mixer and raise it to a spout to be dumped into the forms. Following the development of this particular equipment, which Mr. Humphrey used on a number of houses for the Humphrey Co., in Euclid Beach Park, Mr. Humphrey was impressed with the importance in this and other kinds of work of a continuous mixer of very large capacity. He has built one along the lines shown in the accompanying illustration. This particular equipment is not a finished machine, but it was built up in the Humphrey shop, experimentally, and it has been used for remarkably rapid placing and for securing efficiency in mixing which has been very satisfactory. The outstanding feature of this mixer may be seen in the three inclined cylinders. In the top one is a long metal bar, like a rolling pin; a proportioning bucket elevator lifts the cement from the hopper on one side into this top cylinder, where the water is added, the bar being rolled very rapidly by the turning of the cylinder, this action giving what is believed to be very complete hydration. The grout thus formed discharges into the second cylinder, where the aggregate is added. Interior paddles mix the grout with the aggregate as the cylinder revolves. This discharges in turn into a third cylinder, and from there into the boot of the elevator equipment previously mentioned. It was with this equipment that 35 cu. yds. of concrete were placed in less than $2\frac{1}{2}$ hours.

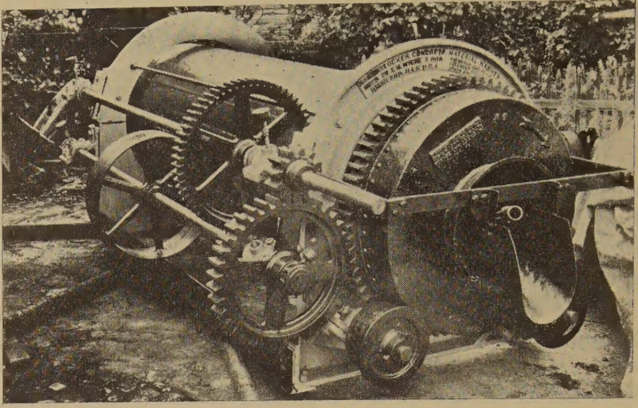
Elementary Concrete Construction—By Leon H. Baxter, Supervisor of Manual Training, St. Johnsbury, Vt.; $6\frac{1}{4}$ by $9\frac{1}{2}$ in.; 101 pp.

This book is a condensed textbook, with a series of simple problems in concrete work which can be successfully worked out by pupils in the seventh and eighth grades. It would also be helpful for anyone wholly ignorant of concrete who desired to do a few things with it for the home.

A short history of the material, its composition, and the classes of cement are followed by paragraphs on the manufacture, from drying and grinding to storing. Line drawings showing the equipment necessary and the illustration from photographs the work being carried on, or the completed job.

If a "concrete" problem is bothering you, ask the Editors. Maybe they can find the solution.

Portable Gravel Washer

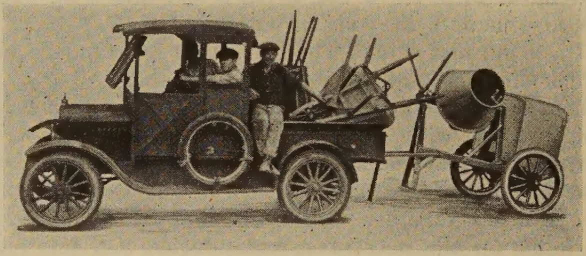


The accompanying illustration shows a type of equipment in which there is a lively interest—a portable gravel washer. This is the Stocker washer. The drum is fitted with scoops and rakes which turn and force the material against a stream of water.

The machine is designed to turn out 10 or more tons per hour, with a water supply of 10 to 15 gals. per minute. A $2\frac{1}{2}$ h. p. gasoline engine will run it.

The equipment weighs less than a ton and is intended for concrete products plants or to be moved about on the job and handle local materials and make them suitable for concreting.

A Trailer-Mixer

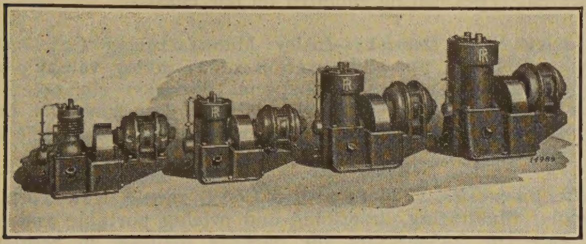


It is obvious that the mobility of a mixer is now considered a very important matter. Several announcements have been made of truck-mounted mixers and now comes a mixer trailer mounted. Its a Jaeger machine—the trailer mixer. It is simply the Jaeger (3-E) mixer, designed for trailer use. In place of front wheels is a foot or support to hold the machine level when mixing. The rear automobile wheels with pneumatic tires add to the ease and speed of portability. When ready to move the contractor simply loads his equipment into his truck—attaches the trailer to the truck and steps on the gas. It is also made in the 4-E size which is called the two-wheel trailer's big brother. It is a heavier machine, therefore requires four automobile wheels instead of two.

Large Excavator Crane

A large size corduroy excavator crane has been developed recently by the Pawling and Harnischfeger Co., Milwaukee, Wis., after two years of experimenting. This machine is of larger capacity than other P. & H. machines, being able to handle a 1 yd. Page dragline bucket on a 35 ft. boom, a $3/4$ yd. Page bucket on a 40 ft. boom, and a ½ yd. Page bucket on a 50 ft. boom. It will also handle clamshell buckets of from ½ to 1½ yds. capacity, depending upon the reach and the material handled. With but a few unimportant changes, it can be converted into a powerful gas shovel, handling a 1 yd. dipper. In addition to being used as a gas shovel or with clamshell and dragline buckets, this machine can be used with backfilling scraper, crane hook or electro-magnet.

It is of the full revolving type, mounted on full corduroy traction, is one-man operated, and is of what is known as all steel construction. Turned shafting, ground to size, is used, the heavy duty shafts being of forged alloy steel. The gears are all of steel, either cast or forged, with teeth cut from the solid block.



New Line of Air Compressors

A new line of small vertical belt driven air compressors known as type fifteen, is announced by the Ingersoll-Rand Co., 11 Broadway, New York. In addition to the plain belt drive design each size is built as a self-contained electric motor outfit, driven through pinion and internal gears, or by employing the short belt drive arrangement. The compressing end and electric motor of both gear and short belt drive units are furnished mounted on a common sub-base, so that they are in no way dependent upon the foundation for correct alignment.

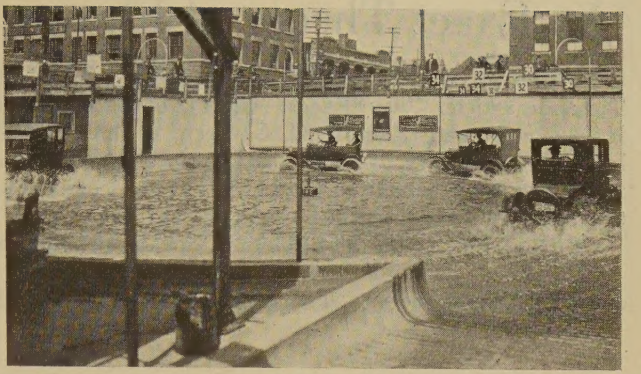
Several noteworthy features of construction have been incorporated, of which the "constant-level" lubrication system is the most important. Others include the constant speed unloader for plain belt drive machines; the centrifugal unloader for start and stop control machines; and the increased size of the water reservoir cooling pot.

The smallest size is built with either ribbed cylinder for air cooling, where the service is intermittent, or a water jacketed cylinder of the reservoir type for constant service. All other sizes are only built with the water jacket of the reservoir type. The size of these reservoir pots is very generous, and one filling will be found sufficient for long periods of operation.

Concrete Wash Bowl Saves Car Owners Labor

The automobile wash bowl shown in the illustration furnishes the latest method of cleaning cars in quick time. One of these bowls is now in successful operation in the city of St. Paul. In this big pool it has been found possible to wash 150 cars in two hours' time on a busy Saturday afternoon. The bowl is a large concrete basin, with an oval track 81 ft. by 63 ft. The bottom of the track slopes in the form of a bowl from 4½ in. depth at the outer edge to 16 in. in the center.

Before the car enters the bowl an attendant straps a rubber cover in place to protect the mechanism. Then the car owner drives his car down the ramp and into the bowl, driving it round and round until he feels that the dirt has been washed from the wheels and the under part of his car. On leaving the wash bowl the car is further cleaned by a number of nozzles, which throw a spray on the running gear. Near by are convenient showers that can be used for giving the tops and sides any extra cleaning that may be required.



Automobile Wash Bowl in St. Paul, Built of Reinforced Concrete

On the bottom of the pool corrugations have been provided on the concrete. These make enough vibration to shake off the mud as the water loosens it. The corrugations are spaced about 5 in. or 6 in. apart and about 1 in. high, and run radially from the center.

The construction is of reinforced concrete, with construction joints dividing the bowl into eight segments, joints being filled with asphalt.

The bowl can be emptied by means of an 8-in. sewer pipe in less than half an hour, and is filled by a 4-in. intake pipe. The sediment that settles toward the center is slushed through into the settling basin with a fire hose. The bowl is emptied about twice a week and is refilled with fresh lake water from the city mains.

Overflow pipes in the center maintain the water level. As the water from the rinsing showers flows down the ramp into the bowl, the oil that accumulates on top of the water is carried off in the overflow pipe.

The bowl shown herewith is an oval, being built so because of the shape of the lot. A circular bowl of 76 ft. diameter is recommended, however, as then the driver could set his wheel and drive faster. A speed of 10 to 12 miles an hour in the bowl gives a better slushing action than a lower speed, loosening the dirt under the fenders more readily.

This device is covered with a basic patent granted the Service Station Construction Co., St. Paul, Minn.

Diagrams prepared by Milan B. Ayres, statistician and analyst, and published in the *Constructor*, of the Associated General Contractors of America, show that in the Civil War period, just as in the World War period today, cost of building increased enormously and that the increase was due very much more to higher prices of materials than to higher wages. It also shows that although wages went up more slowly and relatively much less, they afterwards came down more slowly and relatively not so far as the price of materials.

The diagrames lead to the conclusions that these extreme price changes of the war period are past; that if prices in general again reach the pre-war level it will only be after many years; that wages probably will never go down to the pre-war level; and that the total cost of building is permanently higher than it was before the war.

An Exact Theory of Flexure

In spite of the fact that the proof of C. A. P. Turner's article, "An Exact Theory of Flexure of Homogenous and Reinforced Concrete Beams," published in CONCRETE, October, 1922, was observed carefully, and copy submitted to the author for correction, the following typographical errors crept in:

On page 109, in the first column, "the mean angular distortion" should be $\frac{q}{F}$. The equation $\Delta = \frac{fd}{5F}$ should read $\Delta_s = \frac{fd}{5F}$. At the bottom of the same column, WL^2 should read wL^2 in the numerator of each of the last two equations. In the first column of page 110, the value of the deflection D should be $\frac{1fL^2}{12Eid}$ for central load.

Trade Publications

William A. Serafino, a Youngstown contractor, furnishes the figures for a folder gotten out by the Heltzel Steel Form & Iron Co., Warren, Ohio, from actual costs, using Heltzel curb forms. The folder is entitled, *A Time Study of Curb Construction,* and tells how 324 ft. of Heltzel 12-in. forms and 164 ft. of 6-in. forms were used to handle a job of 1,830 yds. of city street. It tells how two men set an average of 300 ft. of Heltzel 12-in. forms in just two hours.

How to Make Good Buildings Better—King Ventilating Co., Owatonna, Minn., 5 by 7½ in., 16 pp. and cover. This book contains information of a highly practical nature on how farm buildings should be. It is arranged in a convenient form, the question and answer method being used. The following topics are taken up: What constitutes a barn; How much more feed a cow consumes when cold than when comfortably warm; What the important things are anyone should know about a barn before building; How long a barn should be; What kind of material should be in the foundation, and how high it should be; Proper insulation, ventilation, and divisions.

Lower Your Excavating Costs—The T. L. Smith Co., Milwaukee, features the fact that contractors who are using the Smith excavator and loader for many kinds of work—drag line excavating, cellar digging, excavating sand and gravel, stripping, and miscellaneous earth handling—are saving considerable time and money. Illustrations show how contractors are able to *keep their wagons out of the hole* and how they eliminate the need for building and maintaining an incline. The new truck type 4-cylinder motor of 4-in. bore and 5-in. stroke, now used, is also shown.

Handbook of National Steel Lumber—National Pressed Steel Co., Massillon, Ohio; 183 pp., 6⅝ in. by 4¼ in., illustrated. This is the second edition. It embodies complete information and authentic data pertaining to the use of steel lumber sections and kindred materials. The book is founded upon data compiled through a period of 12 years and contains numerous tables for the designer or erector of buildings.

Concrete: Its Manufacture and Use—Koehring Co., Milwaukee, Wis.; 207 pp., 7⅛ in. by 4¼ in., flexible, illustrated. A little handbook that can be carried in the pocket, but which contains a great deal of information concerning the best practice in the manufacture and use of concrete. It is compiled as a book of reference and is written in concise and readable form for the construction man. It contains notes on materials, forms, reinforcing, specifications, estimating, waterproofing and on various structures. The closing chapter is devoted to the maintenance and care of mechanical equipment.

Winter-Proof Concrete and Mortar is the title of a new circular issued by the Cal Chemical Co., Hagerstown, Md., giving directions for winter-proofing concrete with Cal. Among the advantages for Cal is that it is the best insurance against freezing because it gives set and strength in half the time ordinarily required and the concrete is protected against freezing without any additional expense. Cal is designed for use not only in concrete but wherever cement is used. A number of instances where Cal has been used to advantage are mentioned, indicating that its claim has been proven on the job.

Barrett Handling Equipment—Barrett-Cravens Co., 1328 W. Monroe street, Chicago; 9 in. x 4 in., 8 pp., in two colors, describing and illustrating the following types of Barrett equipment: Lift trucks, for moving materials on platforms or racks; Steeleg platforms, for use with trucks; never-slip cranes, chain operated; barrel trucks, for handling barrels, steel or wood, with loose, solid, or liquid contents; portable elevator, for piling, installing heavy motors on hangers, loading wagons and motor trucks, assembling heavy machine parts; and the Powerox, an industrial tractor for use in and between plants and warehouses, or on wharves. It is a truck or tractor as desired and so constructed that bodies of various different types can be mounted on one chassis.

Insley Steel Derricks—Insley Manufacturing Co., Indianapolis, Ind.: 48 pp. and cover, 8 x 11; giving valuable data regarding guy, stiffleg and special derricks, gin poles and erector derricks, including illustrations, diagrams and tables for the solution of problems pertinent to the use of this class of equipment.

The Incinerite, E. C. Stearns & Co., Syracuse, New York. A circular illustrating, describing and pricing portable and built in wall-type incinerators for garbage disposal in residences and public buildings.

Built in Los Angeles, California, from plans by the De Luxe Building Co. Exterior walls of light cream cement stucco on frame; trim, mahogany color; shingle roof, painted red.

Organizations

American Concrete Institute; Secretary, Harvey Whipple, 1807 East Grand Boulevard, Detroit. Convention, Cincinnati, Ohio, January 22-25, 1923.

American Concrete Pipe Association, M. W. Loving, Secretary, 111 West Washington St., Chicago.

American Engineering Standards Comm., Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth Street, New York City, December 14, 1922, 29 W. Thirty-ninth Street, New York City.

Asso. General Contractors of America, G. W. Buchholz, Secretary, 1038 Munsey Bldg., Washington, D. C. Convention probably January 30 to February 2, 1923. Los Angeles, Cal.

Associated Metal Lath Manufacturers, Edison Bldg., Chicago; Wharton Clay, Commissioner.

Portland Cement Association; William M. Kinney, General Manager, 111 West Washington Street, Chicago.

Iowa Cement Stave Silo Association; H. E. Kilmer, Secretary, Oskaloosa, Ia.

Mid-West Concrete Products Assn., Frank Whipperman, Secretary-Treasurer, 3045 Fowler Bldg., Omaha, Neb.

National Crushed Stone Assn.; A. P. Sandles, Secretary, 405 Hartman Bldg., Columbus, Ohio.

National Housing Assn.; Lawrence Veiller, Secretary and Director, 105 East 22nd St., N. Y. C.

The National Lime Association; Mather Bldg., Washington, D. C.

National Sand and Gravel Producers' Association; T. R. Borrows, Acting Secretary, 903 Munsey Bldg., Washington, D. C.

The National Concrete Stave Silo Asociation; W. G. Kaiser, Secretary, 111 West Washington St., Chicago.